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SPRING LAUNCH FEVER

COMMODORE'S ▲ PROLIFERATION

At the Hanover Fair yesterday, April 23rd, Commodore unveiled its long-awaited new product range to the UK Press and dealers.

The VIC 10 is not really a micro, being based around the new generation of video and music devices but it does have the facility for fitting a mini version of VIC BASIC contained in a cartridge with 2K of user RAM.

The Commodore 64 is an interesting beast. Fitted into a VIC-style case, it is based on the new 6510 processor and includes 64K of addressable RAM. When using the built-in BASIC, some 38K of RAM is available for BASIC programs but the BASIC ROMs can be switched out allowing a new language to be loaded into the whole 64K memory area.

The 500 series will be based around the 6509 CPUs and feature expansion to 256K RAM. The range is intended to be fully compatible with the existing range, it has the IEEE port and the kernal of its BASIC is compatible with existing systems. Unfortunately it doesn't have an integral display, relying instead on a conventional TV.

The new super-system is the 700 series and this is a very interesting product indeed. Complete with twin integral discs, detached keyboard and built-in tiltable screen, it not only looks nice but handles well too. Once again it's based on the 6509 processor with 256K of RAM and 340K of disc storage.

Prices for the new systems start at £100 for the VIC 10 (available September), £400 for the Commodore 64 (available October), £695 for the 500 (available September) and £1595 for the 720 with a slimmed-down version called the 710 available at £995 (both released in September).
Henry Budgett

AT THE END OF THE RAINBOW ▼

Well, the rumours were true after all. Today, Clive Sinclair unveiled his new personal computer called, not the ZX82, but the ZX Spectrum.

Based on the Z80A microprocessor, the ZX Spectrum comes in two versions complete with either an internal 16K RAM priced at £125 or with 48K at £175 (both prices are inclusive of VAT). An optional upgrade from 16K to 48K will be offered by Sinclair Research in the near future for around £60.

With a name like the ZX Spectrum, it will come as no surprise that the new machine is capable of high-resolution colour graphics accessed by PLOT, DRAW and CIRCLE. Using an enhanced version of Sinclair's ZX81 BASIC programming language, it is also capable of sound generation and supports up to 52 user-definable functions via a full typewriter-compatible 40 moving-key ASCII keyboard.

An expansion port permits the ZX Spectrum to be linked with the existing Sinclair ZX Printer; other printers will, at a later stage, be able to be used via an RS232 port. A network interface allows the new machine to be linked to other ZX Spectrums and there is further port intended to support up to eight ZX Microdrives. The ZX Microdrive is a microfloppy data storage unit containing 100K for around £50; these units will be released later in the year.

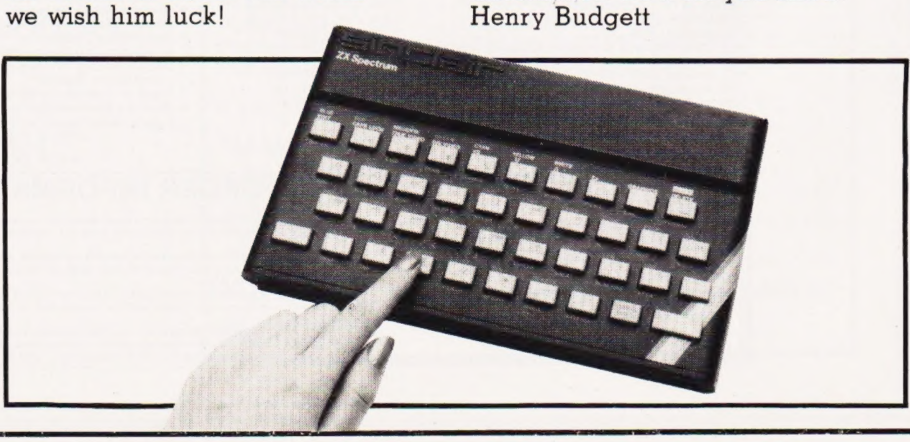
The ZX Spectrum will be available immediately but by mail order only. ZX Spectrums can be ordered by 'phone using Access or Barclaycard 24 hours a day on 01-200 0200 or from Sinclair Research at FREEPOST, Camberley, Surrey GU15 3BR. Clive promises a turnaround time for orders of about two weeks — we wish him luck!

ACORN SECRETS LEAK

If you were looking for a full-feature personal computer and were offered a 6502-based system with BBC BASIC, 32K of user RAM, eight colour graphics on an 8K screen (320 x 200 pixels), dual speed cassette and programmable sound generator you might begin to reach for your wallet. Well, the indications are very strong indeed that come August time Acorn will be launching a mini-version of the BBC micro called The Electron. Chris Curry of Acorn Computers would neither confirm or deny the news but sources close to the company indicate that the plans are very well advanced.

The machine will be sold by Acorn, not the BBC, and is intended to compete directly with the Sinclair's ZX Spectrum. Its expansion capability includes Econet and printer interfaces so it could be used in the classroom as an ATOM replacement. Other built-in goodies include 10 programmable function keys, both PAL and NTSC colour output, indicating that Acorn may be about to attack the US market, and a selectable screen format of 20 by 25 or 40 by 25 offering a direct challenge to the VIC 20 and the slimmed-down Commodore 64 system called the VIC 30.

The price is believed to be between £120 and £150 and the machine will enter volume production during the last quarter of this year. As we get more information we'll let you know!
Henry Budgett



CONSUMER NEWS

APPLE CART▲

And yet another for the Apple II . . .this interface is called PORTAPPLE. It comprises a portable data collection terminal which can store up to 32K of data which can be input through the keyboard and/or a bar-code scanner.

Numerous applications in the field are possible — for example, stock recording, incomplete records, market and industrial research, data processing and order recording.

The retail price of the PORTAPPLE system comprising an 8K data collector, bar-code scanner, bar-code starter pack, interface card and system software is £975. For further information get in touch with Mektronic Consultants, Linden House, 116 Rectory Lane, Prestwich, Manchester M25 5DB or 'phone them on 061-798 0803.

CALLING ALL TEACHERS

Transam Computers and Hutchinson Education have announced a microcomputer software competition aimed at primary and secondary school teachers. Prizes totalling £1,750 will be awarded to the first 12 winners with guaranteed publication of the winning programs.

Entry forms giving full details of the competition are available from 'Prime Programs', 17 Conway Street, London W1P 6JD; you could always 'phone Bob Osborne on 01-387 2811 if you're in a hurry!

Prime Programs are also hoping to publish a book of listings of the 40 best programs submitted other than the prize winners.

STAY SHARP

Receiving a sharp picture? Perhaps you need the multi-screen microcomputer display system introduced for the Sharp range of personal micros.

For the Sharp MZ-80K and MZ-80B, two monochrome models are available: Triple-Vision providing output to a standard UHF or projection TV plus up to 12 monitors with sound and Multi-Vision providing sound and vision on up to 12 monitors fitted with audio playback facilities.

Multi-Vision and Triple-Vision are available from Sharp dealers at £35 and £79 respectively, fitting extra. For further information contact Ian Dunkley, the Managing Director of the Datron Micro Centre, 2 Abbeydale Road, Sheffield S7 1FD or 'phone him on 0742-585400.

HEAT TREATMENT▼

Two 40 character per line printer/plotter models have been added to the Roxburgh range of thermal printer mechanisms.

The PU1840-2P has 20 thermal elements and a print speed of two lines per second. The PU1840-4P has 40 thermal elements and consequently, a print speed of four lines per second. Both models have automatic paper advance at the end of each line and can print graphics as the 280 dots per line are all individually addressable.

The PU1840-2P is priced at £61.50 and the PU1840-4P comes at £67.70; considerable savings can be achieved if you decide to buy 100 off (!). Further details can be made available by 'phoning 07973-3777 and asking for Mike Davis or you could write to him at Roxburgh Printers Ltd, 22 Winchelsea Road, Rye, E Sussex TN31 7BR.

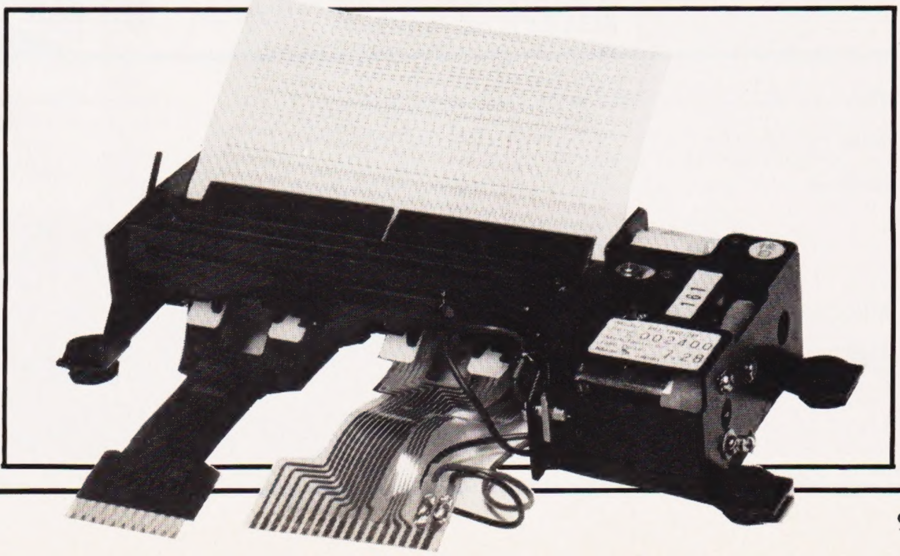
A BIT ON THE SIDE

Have you ever wanted to turn your VIC-20 into a multi-purpose business machine? Well, now you can with an add-on from Beelines Ltd, an associate company of B & B Computers of Bolton.

The 'magic' black box increases the VIC's 22 column display to 40 and expands its memory from 3K to 35K. Apart from a sophisticated colour writer and a 32K RAM board, the box also boasts an additional power supply unit to deal with the extra electronics.

Complete with all connecting cables and a 12 month guarantee, the new interface will sell for £220 plus VAT. It will be available from selected dealers and direct by mail order from Beelines, Freepost, Bolton BL3 6YZ.

For further information on the VIC box and also the new VIC-6 cassette (Volume One contains six programs for £9.95) get in touch with John Blackburn on 0204-382471.

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THREE UP▲

Unlike the Genie I and II, the Genie III is a fully expanded and integrated microcomputer containing 64K of RAM, a built-in screen, a dual disc drive with double-density storage facility and a keyboard with the full ASCII keyset and numeric keypad.

Based on the Z80A CPU, the Genie III includes a parallel port, a serial port and a cassette interface. The system incorporates 5¼" double track double-density disc drives; four drives can be daisy-chained together to provide storage capacity of up to 1.4M. Also, if you're prepared to wait a little, there's talk of double-sided double track drives being available which would effectively double the storage capacity.

No problem with software either, the Genie III is fully programmable in both CP/M and Level II BASIC.

The basic Genie III computers will retail for around £1,600. For further information get in touch with Lowe Electronics, Bentley Bridge, Chesterfield Road, Matlock, Derbyshire or telephone them on 0629-2430.

SWEETLIPS!?!

No, it's not a new character in 'M*A*S*H'...it's an intelligent small-format pen plotter featuring two-colour capability, high resolution plotting and a printing speed of 15 inches per second.

Designated the HP7470, the SWEETLIPS plotter is compatible with a wide variety of both large and small Hewlett-Packard computers, including the HP-87, as well as personal and business computers from IBM, Apple and Commodore.

In all, the HP7470 has an eight-bit MC6802 microprocessor, two CMOS logic gate arrays, an interface LSI chip, an 8K ROM and a 256K RAM.

The price of the SWEETLIPS plotter (with either interface HP-IB (HP's IEEE-488) or RS-232C) is £969 + VAT. For further details contact Hewlett-Packard Ltd, Nine Mile Ride, Easthampstead, Wokingham, Berks RG11 3LL. Telephone enquiries can be made on 03446-3100.

DESKTOP TRIO

Sanyo have introduced three new computers, the MBC 2000, the MBC 3000 and the FDS 1000, especially for the wide range of applications required by small businesses.

The MBC computers desktop design incorporates boards (based on two 8085A microprocessors with 64K of RAM and 4K of ROM), a 12" VDU, a power source and two built-in floppy disc drives. The disc drives in the MBC 2000 and 3000 have storage capacity of 328K and 256K respectively.

The FDS 1000 is based on the Z80A microprocessor and boasts 64K of RAM and 2K of ROM. It is a CP/M machine supporting such high level languages as BASIC, FORTRAN, Pascal and COBOL. The keyboard is separate from the main unit as with the MBC models.

The MBC 2000, the MBC 3000 and the FDS 1000 are priced at £2,950, £4,650 and £1,600 respectively. Further information is available from Sanyo Marubeni (UK) Ltd, 8 Greycaine Road, Greycaine Estate, Watford, Herts WD2 4QU. Telephone enquiries should be made on 0923-46363.

WHERE TO DRAW THE LINE ▼

Utilising a 6 MHz, Z80B processor, the Vector Graphics 5032 is available with an eight inch Winchester disc drive of 32M and the ability to support up to five terminals.

The 5302 system, priced from £9,125, offers true multitasking capability with Vector's own extended CP/M operating system. In addition, the 5032 comes complete with a standard software package which includes Microsoft BASIC-80, SCOPE (editor) and ZSM (assembler). The system will also run other standard CP/M-compatible software with very few exceptions.

For further information on the 5032 or the other Vector Graphic systems write to Almarc Data Systems Ltd, Great Freeman Street, Nottingham NG3 1FR or 'phone them on 0602-52657.

USING YOUR DIGITS▶

An A4 sized portable digital graphics plotter is now available which, like the PL4 XY recorder, can accept digital commands via an IEEE-488 interface bus.

The PD4 plotter can also be supplied with a comprehensive software package for those users who own a Commodore PET. The software, supplied in ROM form, also extends the list of commands to the BASIC interpreter.

The pen can move at over 600 mm/sec and the plotter will recognise off-scale data causing the pen to be raised automatically. The plotter comes complete with an instruction manual containing sample programs and clear guidance on how to program the instrument for a variety of purposes.

Priced at £596 + VAT, the PD4 plotter is manufactured by JJ Lloyd Instruments Ltd, Brook Avenue, Warsash, Southampton S03 6HP; telephone them on 048-95 4221.

A SHADY DEAL?

Available to fit most standard VDUs and mounting arrangements, Homalite low reflectance, contrast enhancement filters are claimed to reduce the problems associated with operator fatigue, eye strain and operator error.

Homalite filters have a low reflectance surface cast into the filter — it is not laminated so it cannot chip or peel. For optimum contrast and improved readability, Homalite filters are colour-matched to a range of specific colours.

If you want to know more about Homalite filters get in touch with SGL International, 76 Euclid Avenue, Haddonfield, New Jersey 08033, USA and ask them to send you the engineering bulletin they have published on the subject. You could always 'phone them on 609 429-7400 but please don't forget the code for the USA (010).

UNDER THE BED

KGB Micros have been appointed a dealer for the OKI IF800 colour graphics computer, a system aimed at technical, engineering and scientific users.

Driven by a Zilog Z80A eight-bit chip under the CP/M operating system, the IF800 has 64K of RAM (expandable up to 256K) and can be supported by a 4K ROM cartridge.

The system includes a QWERTY keyboard, a built-in printer and a screen which can be switched from either eight-hue colour mode to monochrome green mode. Also, to back the central processor, the IF800 has two 400K 5¼" double sided, double-density mini floppy disc drives.

On the software side, the OKI system comes complete with an Extended BASIC interpreter; the IF800 can also handle Microsoft BASIC and Fortran.

The OKI IF800 is priced at £4,750 and is available from KGB Micros Ltd, 14 Windsor Road, Slough, Berkshire SL1 2EJ or telephone 0753-38310.

ARE YOU SITTING COMFORTABLY?▼

Baseline is a range of ergonomically designed furniture for use with computer peripherals, word processors and data processing terminals.

Every item in the range of desks, tables, work platforms, shelves and pedestals is available in either teak, mahogany or real beech wood finishes, all with rounded hardwood edging for durability. All electrical wiring and machine connecting leads can be contained neatly within the desks.

There is too much in the range to give you a good idea of the prices but according to the manufacturers, Baseline should be just 5% of your computer hardware expenditure. If you need more details the best thing would be to write to WH Deane (High Wycombe) Ltd, Wooburn Green, High Wycombe, Bucks HP10 0HH or telephone them on 06285-25011.

BUILDING ON A MICRO

Personal Programmer is a package providing users with an easy way to create custom application programs through an English language interaction without the need to see any program code.

By designing a data entry screen directly on to the VDU, the user can generate a program to handle that input data. In a similar way, by designing a report layout on the screen the package will generate a program to produce that report. The time taken to develop a simple one file, one report program will obviously depend on your typing skill but the package's program generation time is something between 20 seconds and two minutes.

For more information on Personal Programmer or the rest of the Pearl range of business software, contact Pearl Software, Audley Lodge, Glenair Road, Parkstone, Dorset.

WHAT'S THE WORD ON THE TRS-80?

A word processing package called Newscript has been introduced for the TRS-80 Models I and III; the package requires 48K with at least one disc drive to operate efficiently.

Using Newscript, text can be entered, material added or deleted, lines moved around or duplicated and 'global' changes easily carried out. The package also includes features such as centering, right-justification, page numbering and mail-merge.

Supporting most matrix and daisywheel printers, the Newscript package comes complete with a 160 page manual which incorporates a simple self-study tutorial and a reference card.

Newscript is priced at £79 + VAT + post and packing from EA International, 8 High Street, Meldreth, Royston, Herts SG8 6JU.

STOCKING UP

Saba Computer Systems have released the Saba Stock Control system, a package based on Triumph Adler's Alphatronic microcomputer.

Providing a menu-driven format, the program guides the operator step-by-step through all operations using clear prompts to avoid any error routines. The package itself will control up to 1,700 records per disc and, depending on whether one or two single- or double-sided discs are used, a storage of up to 6,800 records can be achieved.

The Stock Control program is available as a stand-alone package for £350 or it can be integrated with the Saba Sales Ledger system, a package which performs all sales accountancy tasks. The Sales Ledger also costs £350.

For further details get in touch with Triumph Adler UK Ltd, MMD, 27 Goswell Road, London EC1M 7AJ or telephone them on 01-250 1717.

COMPUKIT CATALOGUE

A free catalogue detailing some of the latest software for the Compukit UK101 can be yours if you write to Arcadia Software, 4 Chestnut Avenue, West Cross, Swansea SA3 5NL.

Among the 8K programs included are Space Fighter and Asteroids, priced at £3.95 each, Invaders at £2.95 and Chicane Chaser and Astro Sled both priced at £1.95. There is also a 4K Games Pack containing four old favourites priced at £2.95.

All the 8K programs contain sound effects routines for AY-3-8910 or AY-3-8912 based programmable sound generators.

IT'S GOT TO BE DANISH!

Metanic COMAL-80, a high level language from Denmark, is now available on the MultiBoard system.

COMAL-80 contains, besides the full Extended BASIC command set, a number of the structures found in Pascal. With built-in programming support, COMAL-80 is a relatively easy language to learn and debug but, unlike other beginner's languages, it supports a set of structured statements such as IF...ELSE...ENDIF, REPEAT... UNTIL, WHILE...ENDWHILE and CASE...WHEN...ENDCASE which allow the user to define and handle any group of statements as one block.

Each of the two different COMAL-80 packages (one version leaves more storage for the user and takes up a few seconds at the start and end of the program execution for reading the overlay) contains two versions of the COMAL-80 interpreter. Both packages are available on tape or 5¼" disc at £100 + VAT each from any MicroValue dealer.

Further details and a list of dealers may be obtained from Gemini Microcomputers Ltd, Oakfield Corner, Sycamore Road, Amersham, Bucks. Telephone enquiries should be made on 02403-28321.

OPERATING IN A DESERT?▶

How are you coping with your Kontron PSI 80? Maybe you could do with the operating system developed by Phase One Systems Inc called OASIS.

Useful for various laboratory, scientific and commercial applications, the OASIS program development facilities also enhance the graphics capabilities of the Kontron, utilising the 512 x 256 pixel resolution.

Among the options available using OASIS are CONTROL Relational DBMS, File Sort Utility, Bi-Sync 2780/3780 and an IBM 3740 formatter as well as FORTH, FORTRAN, RM COBOL and Pascal languages.

For more detailed information concerning implementation and price contact Kontron Computers at Kontron House, Campfield Road, St Albans, Herts AL1 5JG or 'phone them on 0727-66222.

APPLE TRIO▼

Just when you thought you had everything for your Apple III they go and bring out more and more. Sigh!

The first of the three new packages is called Access III and is priced at £90 + VAT. Access III is a data communications application which enables the user to handle a stand-alone and timesharing tasks.

The second package is called PUL (Pascal Utilities Library) which makes Pascal programming that much easier on the Apple III. Last up is Script III, a professional text editing package enabling the user to format and add style to printed Pascal text files. The price of PUL and Script III are £45 + VAT and £75 + VAT respectively.

More information is available from Apple Computer (UK) Ltd, Finway Road, Hemel Hempstead, Herts HP2 7PS or by telephone on 0442-40573.

SAFE WARES?

A protection package called SAFEWARE is now available for those of you wishing to develop or sell software and protect it from unauthorised access or copy.

This two part package comprises a small hardware unit (a dougle) which plugs into the PET user port and a software interrogation routine. The software routine, placed anywhere within the user's program, checks for the presence of the hardware unit and if absent, inhibits the program. Each SAFEWARE package is individually coded and users are allocated a unique code for each application or commercial software package.

Each SAFEWARE package costs £19.95 and is treated in the strictest confidence. For further details contact David Walker at Mektronic Consultants, Linden House, 116 Rectory Lane, Prestwich, Manchester M25 5DB or telephone him on 061-798 0803.

BARGAIN BYTES

The first of a series of cassettes for the 16K ZX81 has been released offering in excess of 50K of programs combining both 'serious' and 'pleasure' software.

Bargain Bytes 1, like the others to follow, comprises eight programs ranging from Deep Sea Adventure and Underground Adventure to Bank Account and a Foreign Currency Converter. Soon to be released is Bargain Bytes 2 which will include Home Budgeting, a stock marketing game and a seafaring game.

Priced at £5, including post and packing, Bargain Bytes 1 is available now from Richard Shepherd Software, 22 Green Leys, Maidenhead, Berks SL6 7EZ. Telephone enquiries can be made on 0628-21107.

FOOTBALL CRAZY

Remember Professor Frank George's F4 Football Forecast Program from Sporting Forecasts which was available for the Apple, PET, Sharp, TRS-80 and Video Genie at £28.75. Well, there's now a 16K cassette version offered for the PET, TRS-80 and Video Genie at £19.95.

And not only that, they've also released another program which provides the maximum possible coverage of forecast drawn games within the cash available and it's called POOLPERM. This new program is currently available as a 32K disc version for the Apple, PET, Video Genie and TRS-80 and as a 16K cassette version for the PET, Sharp, Video Genie and TRS-80. All are priced at £17.25.

The programs are supplied with a comprehensive booklet and can be obtained from the Bureau of Information Science, Commerce House, High Street, Chalfont St Giles, Bucks HP8 4QH. For further information you could always 'phone them on 02407 4906.

NEXT MONTH

ADVANCED BBC PROGRAMMING

Having received your BBC Micro, worked through the Welcome pack and dipped into the manual, you might be wondering what to do next. Well, if you get hold of next month's issue of Computing Today, you'll find a major feature on advanced programming techniques you can use with this versatile system.

The article will be essential reading for those who are merely *thinking* of buying the system too, as it is intended to show up some of the machine's great strengths over systems supplied with ordinary or Extended BASICs. Indeed, if you are at all interested in producing good, structured pieces of software then this feature is going to be well worth waiting for.

ADDING UTILITIES TO YOUR NASCOM

As well as being one of the very first British personal micros, the NASCOM has always been one of our personal favourites. In our next issue we take a look at how you can build a powerful set of utilities which, unlike the commercial 'toolkits', can be configured to suit your own special needs. Indeed, if you take the ideas presented here far enough you could end up with your own special version of BASIC tailored to your own requirements.

SOFTWARE GALORE

Our July issue will also contain a bonus of some eight pages of Softspot material. These are reader's own programs submitted to the magazine and you can be sure that we have picked out some of the more interesting or fun-to-use material from the vast piles sent in over the last few months.

HANDS-ON A HAND-HELD

If you thought that the PC-1211 was a great little machine, and few didn't, just wait till you read our report on the amazing PC-1500. Quite apart from its in-built features, it is backed up with a number of interesting extras including a four-colour printer which simply has to be seen to be believed.

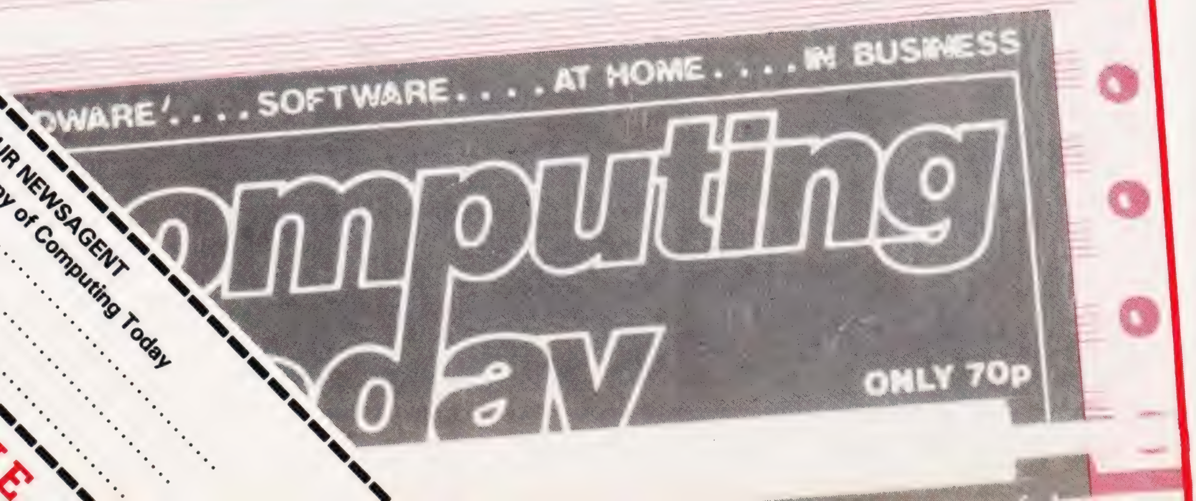
For a look at advanced pocket programming power, you simply can't afford to miss out on our next issue.

WATCHING TANDY'S BASIC AT WORK

The single major failing of most debugging aids you can buy for your system is that they only show you what your program is doing. This program actually shows you what the interpreter is doing to your program, with a real-time screen display of those vital scratchpad locations.

If you're bugged by bugs you can't track down, try adding this utility to your library and see just where they are wrecking your code.

Articles described here are in an advanced state of preparation but circumstances may dictate changes to the final contents.



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JULY ISSUE ON SALE FRIDAY 11th JUNE

Paul Williams

Assembly language programming can seem a real drag until you take advantage of the facilities offered by a package such as this.

A two-pass assembler is a virtual necessity for anyone wanting to start to write complex, well-designed programs at machine code level. The main differences between a two-pass assembler and the more common line-by-line assembler are:

1) A copy of the source code (the assembly code you've typed in) is always retained as a file.
2) Any location or instruction can be given an alphanumeric label up to 10 characters in length. All characters in the label are significant and it must start with a letter.
3) These labels may be used in the operand — that's the address or data section of an instruction. For example, you could label the address 0400 Hex as SCREENTOP and then JMP SCREENTOP. You can also label values so that CHARACTER = $A0 and, where you wanted to load the value A0, use the label CHARACTER instead.

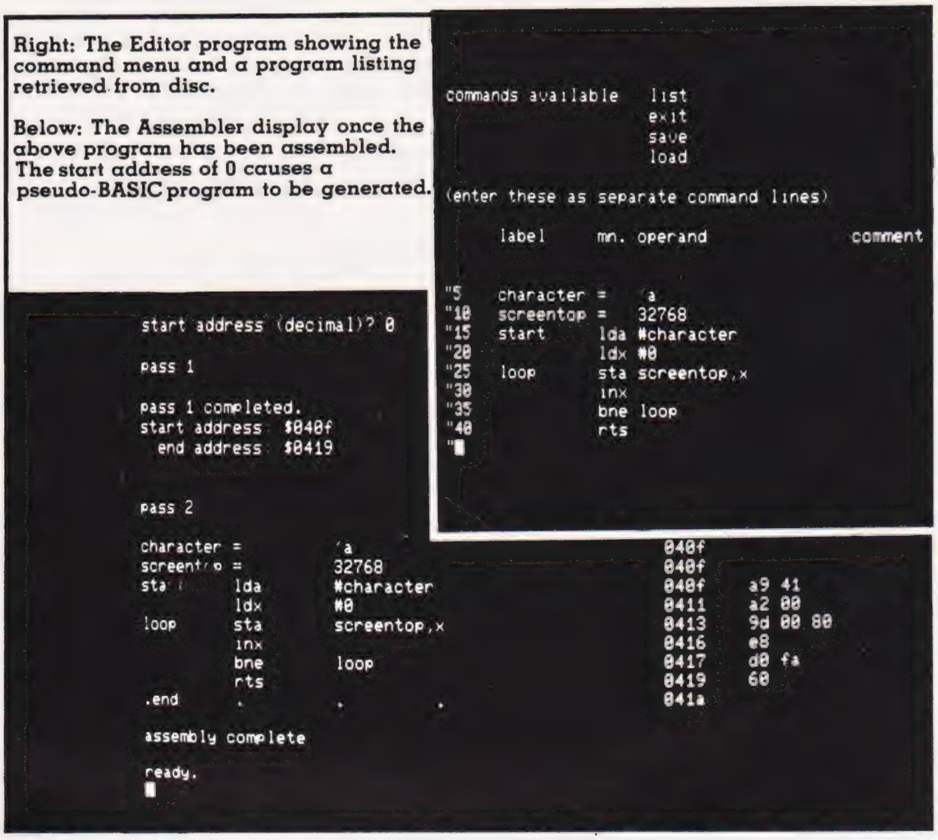
The overwhelming advantage of a two-pass label based system is that instructions or even whole blocks of program can be altered, ammended or added to without worrying about changing the addresses as all this is done by the assembler.

The program published here is disc-based and runs on the Commodore 8032 system. The source program must, therefore, reside on disc and the compiled program will be loaded back onto disc. The compiled version can then be loaded off disc and run as required. It would, of course, be a relatively simple matter to convert the program to work with Commodore's cassette system or, if you are feeling really adventurous, to use two cassettes.

Facilities Available

A number of useful features are built into the program and these are as follows:

1) Assembly may start at any address.
2) All standard 6502 instructions and addressing modes are supported.
3) Zero Page instructions are automatically created where possible to speed up execution.
4) Three types of constant are supported:



Right: The Editor program showing the command menu and a program listing retrieved from disc.

Below: The Assembler display once the above program has been assembled. The start address of 0 causes a pseudo-BASIC program to be generated.

Hex	LDA # $41
Decimal	LDA # 65
ASCII	LDA # 'A

(These all produce A9 41)

The assembler is written in BASIC to aid conversion to other systems; features unique to the Commodore 8032 and the 8050 discs will be dealt with later.

A SYS call to execute the object code automatically can be created so that the machine code program can be RUN from BASIC.

Using The Assembler

In order to demonstrate the use of the two-pass assembler we'll take the following program as an example:

```
CHARACTER  =    'A
SCREENTOP  =    32768
START      LDA  #CHARACTER
           LDX  #0
LOOP       STA  SCREENTOP,X
           INX
           BNE  LOOP
           RTS
```

The value of LOOP will automatically be assigned to the address of the instruction STA SCREENTOP,X at assembly time. This version of the EDITOR program will automatically insert the .END statement when the source code is saved on disc.

To create a source file of this program, load the EDITOR program and, after RUNing it, enter the program as if it were BASIC; that is with a line number in front of each line. The apparently spurious '"' symbol at the beginning of each line is inserted by the EDITOR to allow the use of commas in the operand field. If this symbol were not present the BASIC interpreter would take commas as being data separators with somewhat disastrous results.

The EDITOR uses a scrolling window on the screen of the 8032; the top section of the screen is reserved for the command menu and also shows the fields into which your assembly code should be typed. The TAB key will move the cursor to the next location; this is important as the EDITOR is very fussy about where things appear. There is always an empty field available at the extreme right for comments.

To list the program, type 'list' as your input line; typing 'save' will initiate a save sequence and ask for a filename, 'load' will allow you to enter another piece of source code from disc and 'exit' will exit the EDITOR. The EDITOR will automatically append the suffix .SRC to the filename of any program you save.

It is important to note that the line numbers you have typed in at the beginning of each line are not saved on the disc file so, when you load the source code back into the EDITOR, you will find that the new line numbers are neatly incremented in 5s.

Getting Assembled

Once you have entered the source code and saved it on disc, you can start to assemble it. LOAD the ASSEMBLER program and RUN it. Although this program takes several seconds to set up its arrays, it displays the various mnemonics as they are loaded rather than leaving a blank screen to stare at.

Once the set-up procedure has been completed, the program asks for the filename of the program you wish to assemble. In much the same way as the EDITOR appended the suffix .SRC, the ASSEMBLER appends .OBJ to the filename of the object file. If the filename specified is not found on the disc currently installed in drive 0 the program will stop.

Assuming all is well, the program then asks for the start address of the assembled code and this should be entered in decimal form. If address 0 is entered the assembled code will start with the line

```
10  SYS(1039)
```

at the beginning of the object file which will then be followed by the machine code. As 1039 is the first available address in the Commodore's memory after the one line of BASIC, the program can simply be LOADed and RUN.

The first pass through the source file by the ASSEMBLER will now be executed and this collects all the labels and produces a table of their values. The pass also determines the number of bytes in each instruction as this value will be needed to calculate the label addresses.

If no errors are encountered the second pass is now executed actually creating the object file. A full assembly code and Hex dump is produced on the screen as this pass works through the program. When the source code has been fully assembled the files are closed and the operation complete.

Some Rules Of Syntax

In order to simplify the programs, a number of syntax rules have been established. These are:

1) There must be at least one space between labels and instructions and between instructions and their operands.
2) Comments must be preceded by a semi-colon (;).
3) Hexadecimal values are prefixed by $.
4) Decimal values need no prefix.
5) ASCII values must be prefixed by a single apostrophe (').

Line	Function
Line 120	Contains the number of bytes in instructions with each different addressing mode, in the order: IMMEDIATE ABSOLUTE ZERO-PAGE ACCUMULATOR IMPLIED (INDIRECT,X) (INDIRECT),Y ZERO-PAGE, X ABSOLUTE, X ABSOLUTE, Y RELATIVE (INDIRECT) ZERO-PAGE, Y
Line 130	Sets up the arrays: IN$(X) = List of mnemonic instructions OP%(X,Y) = Op codes H$(X) = Decimal to Hex conversion NB%(X) = Number of bytes for each addressing mode L$(X) = List of labels L%(X) = Addresses of labels
Lines 180-340	Set up the op-code and Hex tables.
Lines 390-410	Determine the filenames.
Lines 420-440	Determine the assembly start address.
Line 450	Opens the source file to read; an equivalent CBM 3000 PET command is: OPEN 1,8,2,"0:"+FS$+",S,R"
Line 470	Aborts if the file is not found. DS on an 8032 computer is set to a number >19 if a disc error is encountered.
Lines 500-680	Perform Pass 1 — a table of the labels and their values from the source file is created. The equivalent of 700 DCLOSE is 700 CLOSE 1.
Lines 700-780	Display the start and end addresses.
Lines 800-1160	Perform Pass 2.
Line 810	Scratches any existing object file of the same name as the one specified.
Lines 860-890	Send the tokenised BASIC line 10 SYS(1039) to the object file if necessary.
Lines 930-940	Send the start address of the object code to the file.
Lines 960-1160	Assemble the source code.
Lines 1180-1270	Convert a Hex string H$ into a decimal value H.
Lines 1290-1320	Convert the decimal value H into a four-digit Hex string H$.
Lines 1340-1370	Convert the ASCII string H$ into the decimal value H.
Lines 1390-2140	Determine the addressing mode (AM) of an instruction and evaluate its operand to a value in H. (GOSUB 21000 to execute.)
Lines 2160-2400	Determine the full machine code version of an assembly language instruction.

```
100  T$=CHR$(137):REM ** TAB SET/RESET FUNCTION
110  Q$=CHR$(34):REM ** DOUBLE QUOTES CHARACTER
120  DIM L$(500,4):REM ** MATRIX TO HOLD ASSEMBLY CODE
130  MX=0:REM ** PROGRAM LINE COUNTER
140  PRINT CHR$(147):REM ** CLEAR SCREEN
150  REM ** CLEAR OLD TABS
160  PRINT CHR$(9);
170  IF POS(0)<>79 THEN PRINT T$;:GOTO 160
180  PRINT
190  REM ** SET NEW TABS
200  PRINT TAB(6);T$;TAB(16);T$;TAB(20);T$;TAB(41);T$
210  PRINT CHR$(147);"COMMANDS AVAILABLE:  LIST"
220  PRINT "[10 SPC]EXIT"
230  PRINT "[10 SPC]SAVE"
240  PRINT "[10 SPC]LOAD"
250  PRINT
260  PRINT "ENTER THESE AS SEPARATE COMMAND LINES"
270  PRINT
280  PRINT CHR$(9);"LABEL";CHR$(9);"MN.";CHR$(9);
     "OPERAND";CHR$(9);"COMMENT"
290  PRINT
300  PRINT CHR$(15):REM ** SET SCROLLING WINDOW
310  REM ** GET A LINE OF TEXT FROM THE KEYBOARD BUFFER
320  POKE 158,2:POKE 623,34:POKE 624,27
330  OPEN 1,0:INPUT#1,A$:CLOSE 1
340  IF A$="" THEN 320
350  REM ** LINE NUMBER OR COMMAND?
360  C$=LEFT$(A$,4)
370  IF C$="LIST" THEN 510
380  IF C$="EXIT" THEN 600
390  IF C$="SAVE" THEN 630
400  IF C$="LOAD" THEN 770
410  L=VAL(C$):IF L>MX THEN MX=L
420  REM ** LOAD THE ARRAY ELEMENTS
430  L$=MID$(A$,6,10):GOSUB 480:L$(L,1)=L$
440  L$=MID$(A$,16,4):GOSUB 480:L$(L,2)=L$
450  L$=MID$(A$,20,21):GOSUB 480:L$(L,3)=L$
460  L$=MID$(A$,41):GOSUB 480:L$(L,4)=L$
470  GOTO 320
480  J=LEN(L$):IF J AND RIGHT$(L$,1)="[SPC]" THEN
     L=LEFT$(L$,J-1):GOTO 480
490  RETURN
500  REM ** LIST ROUTINE
510  PRINT CHR$(19);CHR$(147):REM ** CLEAR LOWER SCREEN
520  FOR X=1 TO MX
530  IF L$(X,1)+L$(X,2)+L$(X,3)+L$(X,4)="" THEN 560
540  PRINT CHR$(34);CHR$(27);MID$(STR$(X),2);CHR$(9);
     L$(X,1);CHR$(9);L$(X,2);
550  PRINT CHR$(9);L$(X,3);CHR$(9);L$(X,4)
560  NEXT X
570  GOTO 320
580  REM ** CLEAR WINDOW AND END
590  REM ** EXIT ROUTINE
600  PRINT CHR$(19);CHR$(19);CHR$(147)
610  END
620  REM ** SAVE ROUTINE
630  INPUT "FILENAME";F$:F$=F$+".SRC"
640  SCRATCH(F$):IF DS>19 THEN STOP
650  DOPEN#1,(F$),W
660  IF DS>19 THEN STOP
670  FOR X=1 TO MX
680  IF L$(X,1)+L$(X,2)+L$(X,3)+L$(X,4)="" THEN 720
690  FOR Y=1 TO 4
700  PRINT#1,Q$;L$(X,Y);Q$
710  NEXT Y
720  NEXT X
730  PRINT#1,"END,.,.,."
740  DCLOSE
750  GOTO 320
760  REM ** LOAD ROUTINE
770  INPUT "FILENAME";F$
780  F$=F$+".SRC"
790  FOR X=1 TO MX
800  FOR Y=1 TO 4
810  L$(X,Y)=""
820  NEXT Y
830  NEXT X
840  DOPEN#1,(F$)
850  IF DS>19 THEN STOP
860  X=0
870  X=X+5
880  FOR Y=1 TO 4
890  INPUT#1,L$(X,Y)
900  NEXT Y
910  IF ST=0 THEN 870:REM ** MORE TO COME
920  DCLOSE
930  L$(X,1)=""
940  L$(X,2)=""
950  L$(X,3)=""
960  L$(X,4)=""
970  MX=X
980  GOTO 510
```

Listing 1. The EDITOR program for the two-pass assembler.

```
100  PRINT CHR$(147):REM ** CLEAR SCREEN
110  REM ** DATA GIVES NUMBER OF BYTES FOR EACH
     INSTRUCTION
120  DATA 2,3,2,1,1,2,2,2,3,3,2,3,2
130  DIM IN$(56),OP%(56,13),H$(255),NB%(13),L$(200),
     L%(200)
140  PRINT:PRINT
150  PRINT "PLEASE WAIT WHILE SETTING-UP IS DONE"
160  PRINT:PRINT
170  SET UP OP-CODE AND HEX TABLES
180  FOR X=1 TO 13
190  READ NB%(X)
200  NEXT X
210  FOR X1=1 TO 56
220  READ IN$(X1)
230  PRINT IN$(X1),
240  FOR Y1=1 TO 13
250  H=-1
260  READ H$
270  IF H$<>"--" THEN GOSUB 1180
280  OP%(X1,Y1)=H
290  NEXT Y1
300  NEXT X1
310  H$="0123456789ABCDEF"
320  FOR X=0 TO 255
330  H$(X)=MID$(H$,X/16+1,1)+MID$(H$,(X AND 15)+1,1)
340  NEXT X
350  PRINT CHR$(147)
360  PRINT "TWO-PASS ASSEMBLER"
370  PRINT
380  REM ** FILE NAME GENERATION
390  INPUT "FILENAME";F$
400  FS$=F$+".SRC"
410  FO$=F$+".OBJ"
420  INPUT "START ADDRESS (DECIMAL)";AD
430  SA=AD
440  IF SA=0 THEN AD=1039
450  DOPEN#1,(FS$):REM ** OPEN FILE ON DISC
460  REM ** IF FILE NOT THERE STOP PROGRAM
470  IF DS>19 THEN PRINT DS$:DCLOSE:STOP
480  PRINT
490  REM ** ASSEMBLE THE LABEL TABLE
500  PRINT "PASS 1"
510  GOSUB 2390
520  IF L1$=".END" OR L2$=".END" THEN 660
530  IF L1$="" THEN 630
540  IF LEFT$(L2$,1)<>"=" THEN 600
550  GOSUB 2040:IF AM<>2 THEN 2990
560  NL=NL+1
570  L$(NL)=L1$
580  L%(NL)=H-32768
590  GOTO 510
600  NL=NL+1
610  L$(NL)=L1$
620  L%(NL)=AD-32768
630  GOSUB 2160
640  AD=AD+NB
650  GOTO 510
660  DCLOSE
670  PRINT
680  PRINT "PASS 1 COMPLETED"
690  REM ** DISPLAY THE START AND END ADDRESSES
700  H=SA
710  IF H=0 THEN H=1039
720  GOSUB 1290
730  PRINT "START ADDRESS: $";H$
740  H=AD-1
750  GOSUB 1290
760  PRINT "END ADDRESS: $";H$
770  PRINT
780  PRINT
790  REM ** START TO ASSEMBLE PROGRAM
800  PRINT "PASS 2"
810  SCRATCH (FO$):REM ** ERASE PREVIOUS VERSION
820  OPEN1,8,2,FS$+",S,R"
830  OPEN2,8,3,"0:"+FO$+",P,W"
840  IF SA THEN 930
850  REM ** CREATE LINE OF BASIC [10  SYS(1039)]
860  PRINT#2,CHR$(1);CHR$(4);
870  PRINT#2,CHR$(13);CHR$(4);CHR$(10);CHR$(0);
880  PRINT#2,CHR$(158);"(1039)";
890  PRINT#2,CHR$(0);CHR$(0);CHR$(0);
900  SA=1039
910  GOTO 960
920  REM ** WRITE START ADDRESS TO DISC
930  HH=INT(SA/256)
940  PRINT#2,CHR$(SA-HH*256);CHR$(HH);
950  REM ** START ASSEMBLY PROPER
960  AD=SA
970  GOSUB 2390
980  IF L1$+L2$+L3$+L4$="" THEN 970
990  PRINT:PRINT L1$,L2$,L3$,L4$,TAB(52);
1000 H=AD
1010 GOSUB 1290
1020 PRINT H$,
1030 IF L1$=".END" OR L2$=".END" THEN 1130
1040 IF L2$="" THEN NB=0:GOTO 970
1050 GOSUB 2160
1060 IF NB=0 THEN 1110
1070 PRINT#2,CHR$(O1);
```

```
1080  PRINT H$(O1);"[SPC]";
1090  IF NB>1 THEN PRINT#2,CHR$(O2);:PRINT H$(O2);"[SPC]";
1100  IF NB>2 THEN PRINT#2,CHR$(O3);:PRINT H$(O3);"[SPC]";
1110  AD=AD+NB
1120  GOTO 970
1130  CLOSE1:CLOSE2
1140  PRINT:PRINT
1150  PRINT "ASSEMBLY COMPLETE"
1160  END
1170  REM ** CONVERT HEX STRING TO H
1180  H=Ø:X=Ø
1190  IF H$="" THEN RETURN
1200  FOR X=1 TO LEN(H$)
1210  Y=ASC(MID$(H$,X,1))
1220  IF Y<48 OR Y>70 THEN 1260
1230  IF Y>64 THEN Y=Y-7
1240  H=H*16+Y-48
1250  NEXT X
1260  X=X+1
1270  RETURN
1280  REM ** CONVERT DECIMAL H INTO HEX STRING
1290  H1=INT(H/256)
1300  H2=H-H1*256
1310  H$=H$(H1)+H$(H2)
1320  RETURN
1330  REM ** CONVERT ASCII STRING TO DECIMAL
1340  H=Ø
1350  IF H$="" THEN RETURN
1360  H=ASC(H$)
1370  RETURN
1380  REM ** DETERMINE ADDRESSING MODE AND EVALUATE ITS
      OPERAND
1390  AM=2:ID=Ø:P=LEN(L3$)
1400  IF P=Ø THEN AM=5:RETURN
1410  I1$=LEFT$(L3$,1)
1420  IF I1$="(" THEN 1510
1430  IF I1$="#" THEN 1660
1440  IF I1$="$" THEN 1800
1450  IF I1$="'" THEN 1760
1460  IF L3$="A" THEN AM=4:RETURN
1470  IF I1$>="Ø" AND I1$<="9" THEN 1840
1480  IF I1$>="A" AND I1$<="Z" THEN 1920
1490  AM=Ø
1500  RETURN
1510  ID=1
1520  I2$=L3$
1530  L3$=MID$(L3$,2)
1540  I1$=LEFT$(L3$,1)
1550  P=LEN(L3$)
1560  GOSUB 1440
1570  I3$=L3$
1580  L3$=I2$
1590  IF LEFT$(I3$,1)<>")" THEN 1640
1600  I3$=MID$(I3$,2)
1610  IF I3$="" THEN AM=12:RETURN
1620  IF I3$<>",Y" THEN AM=Ø:RETURN
1630  AM=7:RETURN
1640  IF I3$<>",X)" THEN AM=Ø:RETURN
1650  AM=6:RETURN
1660  I2$=L3$
1670  L3$=MID$(L3$,2)
1680  I1$=LEFT$(L3$,1)
1690  P=LEN(L3$)
1700  GOSUB 1440
1710  L3$=I2$
1720  AM=1:RETURN
1730  L3$=MID$(L3$,P+1)
1740  IF H>255 THEN HH=INT(H/256):H1=H-HH*256
1750  RETURN
1760  H$=MID$(L3$,2)
1770  GOSUB 1340
1780  P=2
1790  GOTO 1730
1800  H$=MID$(L3$,2):L3$=H$
1810  GOSUB 1180
1820  P=X
1830  GOTO 1730
1840  H=Ø
1850  FOR X=1 TO LEN(L3$)
1860  Y=ASC(MID$(L3$,X,1))
1870  IF Y<48 OR Y>57 THEN 1900
1880  H=H*10+Y-48
1890  NEXT X
1900  P=X-1
1910  GOTO 1730
1920  FOR X=1 TO LEN(L3$)
1930  I3$=MID$(L3$,X,1)
1940  IF (I3$<"A" OR I3$>"Z") AND (I3$<"Ø" OR I3$>"9")
      THEN 1960
1950  NEXT X
1960  P=X-1
1970  I3$=LEFT$(L3$,P)
1980  IF NL=Ø THEN 2030
1990  FOR X=1 TO NL
2000  IF I3$<>L$(X) THEN NEXT X:GOTO 2030
2010  H=L%(X)+32768
2020  GOTO 1730
2030  H=AD:GOTO 1730
2040  AM=2:ID=Ø:ZP=Ø:P=Ø
2050  GOSUB 1390
2060  IF ID=1 THEN 2140
2070  IF AM=1 OR AM=4 OR AM=5 OR AM=12 THEN 2140
2080  IF L3$="" THEN AM=2:GOTO 2130
2090  IF LEFT$(L3$,1)<>"," THEN 2990
2100  IF RIGHT$(L3$,1)="X" THEN AM=9:GOTO 2130
2110  IF RIGHT$(L3$,1)="Y" THEN AM=10:GOTO 2130
2120  GOTO 2990
2130  IF H<256 THEN ZP=1
2140  RETURN
2150  REM ** DETERMINE MACHINE CODE VERSION
2160  NB=Ø:OP=Ø:IN=Ø:A1=Ø
2170  IF L2$="" THEN RETURN
2180  IF L2$="=" THEN RETURN
2190  L2$=LEFT$(L2$,3)
2200  FOR X=1 TO 56
2210  IF L2$=IN$(X) THEN 2240
2220  NEXT X
2230  GOTO 2990
2240  IN=X:GOSUB 2040
2250  IF AM=2 AND OP%(IN,11)>-1 THEN AM=11:GOTO 2330
2260  IF AM=Ø THEN 2990
2270  IF OP%(IN,AM)=-1 AND IN<>49 AND IN<>50 THEN 2990
2280  IF ZP=Ø THEN 2330
2290  IF AM=2 THEN A1=3
2300  IF AM=9 THEN A1=8
2310  IF AM=10 THEN A1=13
2320  IF A1<>Ø AND OP%(IN,A1)>-1 THEN AM=A1
2330  O1=OP%(IN,AM):NB=NB%(AM):IF AM=11 THEN GOSUB 2370
2340  IF NB=2 THEN O2=H:O3=Ø
2350  IF NB=3 THEN O2=H1:O3=HH
2360  RETURN
2370  IF H>AD THEN H=H-AD-2:RETURN
2380  H=254-AD+H:RETURN
2390  INPUT#1,L1$,L2$,L3$,L4$
2400  RETURN
2410  REM ** TABLE OF 65Ø2 INSTRUCTIONS AND HEX
      EQUIVALENTS
2420  DATA ADC,69,6D,65,--,--,61,71,75,7D,79,--,--,--
2430  DATA AND,29,2D,25,--,--,21,31,35,3D,39,--,--,--
2440  DATA ASL,--,ØE,Ø6,ØA,--,--,--,16,1E,--,--,--,--
2450  DATA BCC,--,--,--,--,--,--,--,--,--,--,9Ø,--,--
2460  DATA BCS,--,--,--,--,--,--,--,--,--,--,BØ,--,--
2470  DATA BEQ,--,--,--,--,--,--,--,--,--,--,FØ,--,--
2480  DATA BIT,--,2C,24,--,--,--,--,--,--,--,--,--,--
2490  DATA BMI,--,--,--,--,--,--,--,--,--,--,3Ø,--,--
2500  DATA BNE,--,--,--,--,--,--,--,--,--,--,DØ,--,--
2510  DATA BPL,--,--,--,--,--,--,--,--,--,--,1Ø,--,--
2520  DATA BRK,--,--,--,--,ØØ,--,--,--,--,--,--,--,--
2530  DATA BVC,--,--,--,--,--,--,--,--,--,--,5Ø,--,--
2540  DATA BVS,--,--,--,--,--,--,--,--,--,--,7Ø,--,--
2550  DATA CLC,--,--,--,--,18,--,--,--,--,--,--,--,--
2560  DATA CLD,--,--,--,--,D8,--,--,--,--,--,--,--,--
2570  DATA CLI,--,--,--,--,58,--,--,--,--,--,--,--,--
2580  DATA CLV,--,--,--,--,B8,--,--,--,--,--,--,--,--
2590  DATA CMP,C9,CD,C5,--,--,C1,D1,D5,DD,D9,--,--,--
2600  DATA CPX,EØ,EC,E4,--,--,--,--,--,--,--,--,--,--
2610  DATA CPY,CØ,CC,C4,--,--,--,--,--,--,--,--,--,--
2620  DATA DEC,--,CE,C6,--,--,--,--,D6,DE,--,--,--,--
2630  DATA DEX,--,--,--,--,CA,--,--,--,--,--,--,--,--
2640  DATA DEY,--,--,--,--,88,--,--,--,--,--,--,--,--
2650  DATA EOR,49,4D,45,--,--,41,51,55,5D,59,--,--,--
2660  DATA INC,--,EE,E6,--,--,--,--,F6,FE,--,--,--,--
2670  DATA INX,--,--,--,--,E8,--,--,--,--,--,--,--,--
2680  DATA INY,--,--,--,--,C8,--,--,--,--,--,--,--,--
2690  DATA JMP,--,4C,--,--,--,--,--,--,--,--,--,6C,--
2700  DATA JSR,--,2Ø,--,--,--,--,--,--,--,--,--,--,--
2710  DATA LDA,A9,AD,A5,--,--,A1,B1,B5,BD,B9,--,--,--
2720  DATA LDX,A2,AE,A6,--,--,--,--,--,BE,--,--,B6
2730  DATA LDY,AØ,AC,A4,--,--,--,--,B4,BC,--,--,--,--
2740  DATA LSR,--,4E,46,4A,--,--,--,56,5E,--,--,--,--
2750  DATA NOP,--,--,--,--,EA,--,--,--,--,--,--,--,--
2760  DATA ORA,Ø9,ØD,Ø5,--,--,Ø1,11,15,1D,19,--,--,--
2770  DATA PHA,--,--,--,--,48,--,--,--,--,--,--,--,--
2780  DATA PHP,--,--,--,--,Ø8,--,--,--,--,--,--,--,--
2790  DATA PLA,--,--,--,--,68,--,--,--,--,--,--,--,--
2800  DATA PLP,--,--,--,--,28,--,--,--,--,--,--,--,--
2810  DATA ROL,--,2E,26,2A,--,--,--,36,3E,--,--,--,--
2820  DATA ROR,--,6E,66,6A,--,--,--,76,7E,--,--,--,--
2830  DATA RTI,--,--,--,--,4Ø,--,--,--,--,--,--,--,--
2840  DATA RTS,--,--,--,--,6Ø,--,--,--,--,--,--,--,--
2850  DATA SBC,E9,ED,E5,--,--,E1,F1,F5,FD,F9,--,--,--
2860  DATA SEC,--,--,--,--,38,--,--,--,--,--,--,--,--
2870  DATA SED,--,--,--,--,F8,--,--,--,--,--,--,--,--
2880  DATA SEI,--,--,--,--,78,--,--,--,--,--,--,--,--
2890  DATA STA,--,8D,85,--,--,81,91,95,9D,99,--,--,--
2900  DATA STX,--,8E,86,--,--,--,--,--,--,--,--,--,96
2910  DATA STY,--,8C,84,--,--,--,--,94,--,--,--,--,--
2920  DATA TAX,--,--,--,--,AA,--,--,--,--,--,--,--,--
2935  DATA TAY,--,--,--,--,A8,--,--,--,--,--,--,--,--
2940  DATA TSX,--,--,--,--,BA,--,--,--,--,--,--,--,--
2950  DATA TXA,--,--,--,--,8A,--,--,--,--,--,--,--,--
2960  DATA TXS,--,--,--,--,9A,--,--,--,--,--,--,--,--
2970  DATA TYA,--,--,--,--,98,--,--,--,--,--,--,--,--
2980  REM ** ERROR MESSAGE
2990  PRINT:PRINT:PRINT:PRINT:PRINT "*** ERROR ***"
3000  PRINT L1$,L2$,L3$,L4$
3010  DCLOSE:CLOSE1:CLOSE2
3020  STOP
```

Listing 2. The Assembler program.

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A VOTING LOADER

Rod Humphreys

Increasing the speed of tape-based operations tends to increase the chances of data errors. This utility removes virtually all these problems by taking a vote on the reliability of the information it has read.

It was when my second backup copy of FORTH announced loading errors that I realised something had to be done. There I was, surrounded by loaders and tape recorders with four different Baud rates and none of it was any use. The trouble with my existing loading techniques was that they would only detect loading errors. What I needed was a loader that would detect the errors, but still load the program correctly.

The State Of Play

Let us review the present situation:

1) Most problems arise when loading machine code. A properly designed loader for a high level language like BASIC will carry on loading in spite of errors. Any error which may have occurred will usually be obvious and therefore possible (I don't mean easy) to correct. (My idea of a properly designed loader may not be the same as the people who wrote your software.)

2) The fastest and most straightforward way of saving a program is simply to transfer whole bytes from memory in sequence at the highest Baud rate your equipment will support.

3) If the hardware is correct there does not seem to be a greater error rate at the higher Baud rates.

4) Difficulties experienced in loading other people's tapes are usually due to incompatability in tape recorders. The problem is not usually one of tape speed but of azimuth setting. It is best resolved by attempting to load only one track from a good quality stereo recorder. Problems encountered when loading one's own tapes are more likely to be due to tape dropout or electrical noise on the main supply.

To detect a loading error in a machine code program, the most common technique employed is that of 'checksum' — as each group of n bytes of code is sent to tape it is added into a register. The total may be the actual sum or just the remainder, depending on how many registers are used. This total is then sent out after the last item in the group. The number n can be a constant, say 256, or may be sent out to tape immediately after the address of that particular group. When the program is loaded, the incoming bytes are again added and then compared with the correct total which follows.

This type of loader proves to be quite good at detecting errors. On occasion, two compensating errors may pass undetected but this is rare. The chief disadvantage is that, if several errors do occur, it doesn't usually help matters to try again.

In order to reduce errors,several methods are employed. The most usual is to recommend saving backup copies at 300 Baud. The occasional lunatic will sometimes recommend a paper tape punch at 110 Baud. I admit this actually works, but I couldn't live with it!

Another technique is to adopt something like HEX DUMP. This is a method whereby each byte is divided into two four-bit Hex numbers, then converted to the equivalent ASCII code and sent to tape followed by a CR (Carriage Return). One can only assume that by taking three times as long it is exposed to three times the risk of dropout error.

It is my considered opinion that such methods are only of value when they help to compensate for hardware that is less than satisfactory (That should attract some flak!).

If we are to take three times the minimum loading time then we can make better use of this sacrifice.

The Casting Vote

One way to ensure that a program had loaded correctly would be to load two versions of the same program and then compare them to see if they are identical. Better than this would be to load three versions and allow them to 'vote' on which is the correct value for each location. This last method forms the basis of the voting loader described here.

The program is written for the 6502 microprocessor and uses some simple routines available in the CEGMON monitor; these are not essential and may be either written in code, obtained from your own monitor or left out. The source code consists of two routines, one for save and one for load. The program saves and loads whole pages; by pages, we mean sections of memory of 256 bytes. When using Hex notation, this refers to the first two digits of an address thus the address $IE34 refers to an address in page $IE.

SAVE The starting page is specified together with the number of pages to be saved. Each page is sent out to tape three times in succession followed by a set number of nulls.

LOAD The starting page is specified. This means that a program can be loaded anywhere in memory, regardless of the address from which it was saved. The first three pages are loaded directly into memory starting at the page specified. During the nulls which follow, the three pages are compared. If at least two or three locations agree, then that value is placed in the lower page. If all three address locations are different then the address together with the three alternatives are printed on the screen. When the comparison of the three pages is complete, the number of voting decisions made is displayed on the screen. Thus a normal load is accompanied by 00 for each page loaded. If the display includes any other number such as 03 then loading errors have occurred but the program is still correct.

Program Notes

This method of loading requires that at least two pages of memory must be available above the finished program. The printing on screen of errors is useful but not strictly necessary. Providing that a tally of voting errors is kept somewhere in memory, there need be no printing on the screen.

The number of nulls used in the program (line 490) is satisfactory at 4800 Baud. It may be reduced if the loader is normally used at lower speeds or if printing on the screen does not occur between pages. The program was developed on a UK101 computer, although this is only relevant to the availability of zero page ▷

locations, the screen address and the ACIA address. There seems no reason to suppose that the program could not be adapted for use on any system.

It is also possible to calculate the probability of a successful load of one page. This depends on the number of errors encountered; the chance of two coinciding errors becomes rapidly greater as the error rate increases. The graph (Fig. 1) shows the probability of success plotted against the average number of errors in each 256 bytes. It can be seen that there is only a one in five chance of failure with as many as four errors in each page loaded.

It may occur to you that there is a possibility that the starting symbol may be corrupted thus preventing the load of a page. You are correct. This cannot be entirely avoided but is minimised by the method adopted. The actual probability is 1/769. Consider as a contrast the probability of corruption in many conventional loaders, where the start address, number of bytes and actual checksum are *all* at risk. You will realise if you think along these lines that it is best to maintain a good ratio of start byte to total bytes, and the page seems to be a suitable compromise.

The Voting Loader has been in regular use, by myself and friends, for eight months. In practice it has been of even more value than indicated by initial tests. It copes particularly well with low error rates (with an error rate greater than 10 there is a tendency to lose control of the situation entirely). The loader seems to perform in accordance with the graph shown, with the additional bonus that most errors encountered in practice are of low frequency. Permanent errors due to tape dropout and other temporary effects due to electrical noise (or even low volume control setting) have also been successfully overcome.

Notwithstanding my earlier comments, it has also proved invaluable in loading other people's tapes. In fact nowadays I tend to regard a loading error with tolerance and understanding. After all, one cannot expect perfect tapes, can one? Oh incidentally, on the whole, it might be best to put it in EPROM.

```
        ACIA1=$FØØØ   Status Register of ACIA
        ACIA2=$FØØ1   Data Register of ACIA

      *** Monitor Subroutines Used ***

       MSTART=$F97E   Monitor entry
        SPACE=$FBE6   Print space on display
         CRLF=$FBF5   Print CR LF
       PRINT1=$FEBD   Prints data byte in $FC
       PRINT2=$FEAC   Print address in $FE/$FF,
                      space, value in $FC
                      displayed
       SCNCLR=$FE59   Clears screen


            *** SAVE ROUTINE ***

To save a  program put first page in $F7, number
of pages in $F8. Enter program at $1FØ3.

1FØØ 4C 5Ø 1F           JMP LOAD
1FØ3 A5 F7      SAVE    LDA $F7      Transfer 1st
1FØ5 85 FA              STA $FA      page number
1FØ7 A9 ØØ              LDA #Ø
1FØ9 A8                 TAY
1FØA 85 F9              STA $F9
1FØC A9 DB      NEXB    LDA #$DB     Graphic cross
1FØE 8D 29 D1           STA $D129    Store on scrn
1F11 2Ø 43 1F           JSR TAPOUT
1F14 A9 Ø3              LDA #3       Send 3 copies
1F16 85 FB              STA $FB
1F18 B1 F9      LOO2    LDA ($F9),Y
1F1A 2Ø 3C 1F           JSR OUT1     Send a byte
1F1D C8                 INY
1F1E DØ F8              BNE LOO2     Loop for 256
1F2Ø C6 FB              DEC $FB      Second copy
1F22 DØ F4              BNE LOO2
1F24 AØ CØ              LDY #$CØ     Send nulls,
1F26 A9 ØØ              LDA #Ø       adjust to
1F28 2Ø 3C 1F   LOO3    JSR OUT1     suit baud
1F2B C8                 INY          rate
1F2C DØ FA              BNE LOO3
1F2E E6 FA              INC $FA
1F3Ø C6 F8              DEC $F8      Another page
1F32 DØ D8              BNE NEXB     Last one?
1F34 A9 E2              LDA #$E2     Done, send
1F36 2Ø 43 1F           JSR TAPOUT   of load
1F39 4C 7E F9           JMP MSTART   Exit
1F3C 8D A9 D1   OUT1    STA $D1A9    Screen shows
1F3F 2Ø 43 1F           JSR TAPOUT   save progress
1F42 6Ø                 RTS
1F43 48         TAPOUT  PHA          Save byte
1F44 AD ØØ FØ   TEST1   LDA ACIA1    Check ACIA,
1F47 4A                 LSR A        is bit 1 set?
1F48 4A                 LSR A
1F49 9Ø F9              BCC TEST1    Keep looking
1F4B 68                 PLA          Get next byte
1F4C 8D Ø1 FØ           STA ACIA2    and send it
1F4F 6Ø                 RTS
```

```
                  *** LOAD ROUTINE ***

To load a program put first page in $F7. Enter
program at $1FØØ.

1F5Ø 2Ø 59 FE     LOAD    JSR SCNCLR  Clear screen
1F53 A5 F7                LDA $F7
1F55 85 FA                STA $FA
1F57 A9 ØØ        NPAGE   LDA #Ø
1F59 AA                   TAX
1F5A 85 F9                STA $F9
1F5C A8                   TAY
1F5D 2Ø DF 1F     IDENT   JSR IN1     Get byte
1F6Ø C9 E2                CMP #$E2    End of load?
1F62 DØ Ø3                BNE NEWB    No so branch
1F64 4C 7E F9             JMP MSTART  Exit
1F67 C9 DB        NEWB    CMP #$DB    Start of
1F69 DØ F2                BNE IDENT   block?
1F6B A9 Ø3                LDA #3      3 copies
1F6D 85 F8                STA $F8
1F6F 2Ø EC 1F     LOO4    JSR IN2     Get next byte
1F72 91 F9                STA ($F9),Y Store it
1F74 C8                   INY
1F75 DØ F8                BNE LOO4    Loop for 256
1F77 E6 FA                INC $FA
1F79 C6 F8                DEC $F8
1F7B DØ F2                BNE LOO4    Done 3?
1F7D C6 FA                DEC $FA
1F7F B1 F9        LOO5    LDA ($F9),Y
1F81 85 E3                STA $E3     Load one byte
1F83 C6 FA                DEC $FA     from each
1F85 B1 F9                LDA ($F9),Y page.
1F87 85 E2                STA $E2
1F89 C6 FA                DEC $FA
1F8B B1 F9                LDA ($F9),Y
1F8D 85 E1                STA $E1
1F8F C5 E2                CMP $E2     Compare 1,2
1F91 DØ 18                BNE ERROR1  Equal?
1F93 C5 E3                CMP $E3     Compare 1,3
1F95 FØ Ø1                BEQ NORMAL  All OK
1F97 E8           RECERR  INX         Error count
1F98 E6 FA        NORMAL  INC $FA     Adjust to 3rd
1F9A E6 FA                INC $FA     page address
1F9C C8                   INY
1F9D DØ EØ                BNE LOO5    Done 256?
1F9F 2Ø F5 FB             JSR CRLF    Output the
1FA2 86 FC                STX $FC     number of
1FA4 2Ø BD FE             JSR PRINT1  errors
1FA7 C6 FA                DEC $FA     Set next
1FA9 DØ AC                BNE NPAGE   block addrs
1FAB C5 E3        ERROR1  CMP $E3     Compare 1,3
1FAD FØ E8                BEQ RECERR  OK?
1FAF 85 FC                STA $FC     Save 1
1FB1 A5 E2                LDA $E2
1FB3 C5 E3                CMP $E3     Compare 1,3
1FB5 DØ Ø5                BNE ERROR2  OK?
1FB7 91 F9                STA ($F9),Y Save correct
1FB9 4C 97 1F             JMP RECERR  value
```

A VOTING LOADER

```
1FBC 2Ø F5 FB      ERROR2 JSR CRLF     None agree
1FBF 84 FE                STY $FE      Display addrs
1FC1 A5 FA                LDA $FA      and the three
1FC3 85 FF                STA $FF      alternatives
1FC5 2Ø AC FE             JSR PRINT2
1FC8 2Ø E6 FB             JSR SPACE
1FCB A5 E2                LDA $E2
1FCD 85 FC                STA $FC
1FCF 2Ø BD FE             JSR PRINT1
1FD2 2Ø E6 FB             JSR SPACE
1FD5 A5 E3                LDA $E3
1FD7 85 FC                STA $FC
1FD9 2Ø BD FE             JSR PRINT1
1FDC 4C 97 1F             JMP RECERR
1FDF AD ØØ FØ      IN1    LDA ACIA1    Check ACIA,is
1FE2 4A                   LSR A        register full
1FE3 9Ø FA                BCC IN1      Keep looking
1FE5 AD Ø1 FØ             LDA ACIA2    Get next byte
1FE8 8D 29 D1             STA $D129    Store on scrn
1FEB 6Ø                   RTS
1FEC AD ØØ FØ      IN2    LDA ACIA1
1FEF 4A                   LSR A
1FFØ 9Ø FA                BCC IN2
1FF2 AD Ø1 FØ             LDA ACIA2
1FF5 8D A9 D1             STA $D1A9    Screen shows
1FF8 6Ø                   RTS          load progress
```

The program shown above, whilst not guaranteeing success at every attempt, should significantly decrease your loading errors — especially at high speeds.

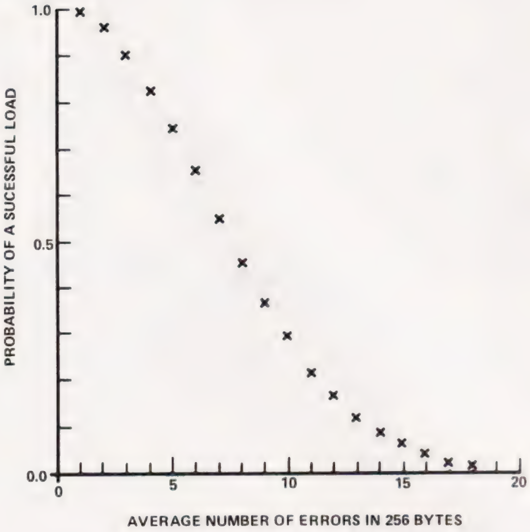

Fig. 1. This graph shows the performance of the Voting Loader. As can be seen, even if you have up to four errors in any one page (256 bytes) you still stand a very good chance of getting a successful load.

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REFLECTIONS

G W Gallagher

The next stage in our look at elementary graphics programming is the construction of border patterns.

When translation parallel to one chosen direction is added to the transformations of reflection and rotation (covered in last month's CT), we can now generate seven different border patterns from one element of pattern.

The border itself, produced to infinity in either direction, must have the same order of symmetry as the point symmetry developed with the pattern element. For example, if the basic element is reflected in an axis parallel to the direction of translation before being translated, then the whole of the border pattern has reflective symmetry of the same order. This restricts the point symmetries which may be used to the following types:

A.  Rotation through 360 degrees, ie the basic element itself.

B.  Reflection in an axis perpendicular to the direction of translation.

C.  Reflection in an axis parallel to the direction of translation.

D.  Reflection in both these axes.

E.  Rotation through 180 degrees about a point on the axis of translation.

The seven border patterns are then generated as follows:

1. Translation of the basic unit A.

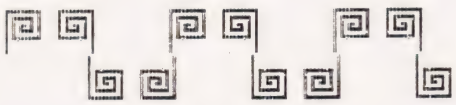
2. Translation of B.

3. Translation of C.

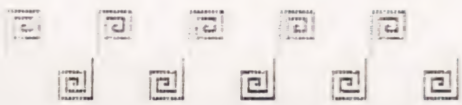
4. Translation of D.

5. Translation of A, followed by reflection (called a glide reflection).

6. Glide reflection of B.



7. Translation of E.



Back To Basics

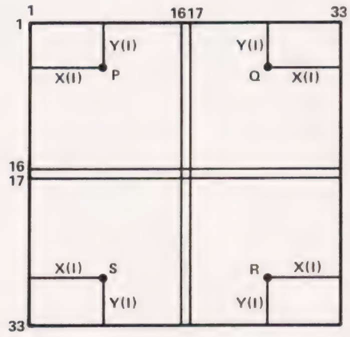
The basic element in the program is contained in a 16 by 16 square of points. The co-ordinates of the points are either read in as data or given as input from the keyboard using arrays X(88) and Y(88) to hold the values of x and y.

Lines 100-116 contain the data for a basic shape, in this case, 67 points. The co-ordinates, enclosed within the 16 by 16 square, are read in point by point, the y co-ordinate following the x co-ordinate. Line 120 passes on the number of points, N, to the pattern-making program.

```
130   FOR I=1 TO N:
      READ X(I),Y(I):
      NEXT I
```

Lines 500 to 590 contain the program to build up the basic shape to be used from the keyboard, with a maximum of 88 points (see last month's article on Point Symmetry).

To form shapes A,B,C,D and E



Consider one point P of the basic shape.

P has co-ordinates X(I),Y(I)

Q 33-X(I),Y(I)

R 33-X(I),33-Y(I)

S X(I),33-Y(I)

Shape A uses point P

```
2000  HGR:HCOLOR=3:
      FOR I=1 TO N:
      P=100+X(I):Q=40+Y(I):
      HPLOT P,Q:
      NEXT I:
      RETURN
```

Shape B uses points P and Q

```
2100  HGR:HCOLOR=3:
      FOR I=1 TO N:
      P1=100+X(I):Q1=40+Y(I):
      P2=133-X(I):Q2=Q1:
      HPLOT P1,Q1:HPLOT P2,Q2:
      NEXT I:
      RETURN
```

Shape C uses points P and S

```
2200  HGR:HCOLOR=3:
      FOR I=1 TO N:
      P1=100+X(I):Q1=40+Y(I):
      P2=P1:Q2=73-Y(I):
      HPLOT P1,Q1:HPLOT P2,Q2:
      NEXT I:
      RETURN
```

Shape D uses points P,Q,R and S

```
2300  HGR:HCOLOR=3:
      FOR I=1 TO N:
      P1=100+X(I):Q1=40+Y(I):
      P2=133-X(I):Q2=Q1:
      P3=P1:Q3=73-Y(I):
      P4=P2:Q4=Q3:
      HPLOT P1,Q1
2310  HPLOT P2,Q2:HPLOT P3,Q3:
      HPLOT P4,Q4:
      NEXT I:
      RETURN
```

Shape E uses points P and R

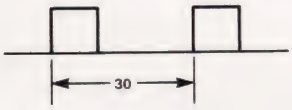
```
2400  HGR:HCOLOR=3:
      FOR I=1 TO N:
      P1=100+X(I):Q1=40+Y(I):
      P2=133-X(I):Q2=73-Y(I):
      HPLOT P1,Q1:HPLOT P2,Q2:
      NEXT I:
      RETURN
```

On The Border

Having worked out the basic shapes, it is then necessary to move them horizontally across the screen for regular distances. The line of translation used is, on the Apple screen, 100 units from the top of the screen, and is shown in Pattern 1 which is the basic element A translated.

```
2500  FOR K=1 TO 270 STEP 2:
      HPLOT K,100:
      NEXT K
```

Pattern 1. Element A (16 by 16) will fit into the width of the screen eight times if a distance of 30 units is placed between the same points on consecutive repeats.




```
2520  FOR J=0 TO 7:FOR I=1 TO N:
      P=J*30+X(I):Q=84+Y(I):
      HPLOT P,Q:
      NEXT I
2560  GOSUB 4100:
      NEXT J:
      RETURN
```

The line of translation is then erased by plotting with HCOLOR=0.

```
2570  HCOLOR=0:
      FOR K=1 TO 270:
      HPLOT K,100:
      NEXT K:
      RETURN
```

The end of each repeat of the pattern is marked by a 'bleep'.

```
4100  FOR B=1 TO 10:
      S=PEEK(-16336):
      NEXT B:
      RETURN
```

Pattern 2. The element B is 33 points wide and 16 points deep. It is repeated seven times across the screen, with a distance of 35 units between consecutive repeats of the same point of B.

```
2700  FOR J=0 TO 6:FOR I=1 TO N:
      P1=J*35+X(I):Q1=84+Y(I):
      P2=J*35+33-X(I):Q2=Q1:
      HPLOT P1,Q1:HPLOT P2,Q2:
      NEXT I
2800  GOSUB 4100:
      NEXT J:
      RETURN
```

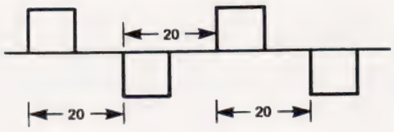
Pattern 3. The element C is 16 points wide, 33 points deep and is repeated seven times across the screen.

```
2900  FOR J=0 TO 6:FOR I=1 TO N:
      P1=J*35+X(I):Q1=84+Y(I):
      P2=P1:Q2=117-Y(I):
      HPLOT P1,Q1:HPLOT P1,Q2:
      NEXT I
3000  GOSUB 4100:
      NEXT J:
      RETURN
```

Pattern 4. The element D is 33 points wide and 33 points deep and is again repeated seven times across the screen.

```
3100  FOR J=0 TO 6:FOR I=1 TO N:
      P1=J*35+X(I):Q1=84+Y(I):
      P2=P1:Q2=117-Y(I):
      P3=J*35+33-X(I):Q3=Q1:
      P4=P3:Q4=Q2
3170  HPLOT P1,Q1:HPLOT P2,Q2:
      HPLOY P3,Q3:HPLOT P4,Q4:
      NEXT I
3250  GOSUB 4100:
      NEXT J:
      RETURN
```

Pattern 5. The element A is itself 16 by 16 points but the element is reflected in the axis of translation, half way between the repeats of element A.




```
3300  FOR J=0 TO 5:FOR I=1 TO N:
      P1=J*40+X(I):Q1=84+Y(I):
      HPLOT P1,Q1:
      NEXT I
3400  FOR I=1 TO N:
      P2=J*40+X(I)+20:Q2=117-Y(I):
      HPLOT P2,Q2:
      NEXT I
3410  P2=J*40+X(I)+20:Q2=117-Y(I)
3450  GOSUB 4100:
      NEXT J:
      RETURN
```

Pattern 6 The glide reflection is formed as in Pattern 5, using the element B (33 by 16 points).

```
3500  FOR J=0 TO 5:FOR I=1 TO N:
      P1=J*40+X(I):Q1=84+Y(I):
      P2=J*40+33-X(I):Q2=Q1:
      HPLOT P1,Q1:HPLOT P2,Q2:
      NEXT I
3580  FOR I=1 TO N:
      P3=J*40+20+X(I):Q3=117-Y(I):
      P4=J*40+20+33-X(I):Q4=Q3:
      HPLOT P3,Q3:HPLOT P4,Q4:
      NEXT I
3635  GOSUB 4100:
      NEXT J:
      RETURN
```

Pattern 7. The element E is 33 by 33 points and is repeated six times.

```
3700  FOR J=0 TO 5:FOR I=1 TO N:
      P1=J*40+X(I):Q1=84+Y(I):
      HPLOT P1,Q1:
      NEXT I
3800  FOR I=1 TO N:
      P2=J*40+33-X(I):Q2=117-Y(I):
      HPLOT P2,Q2:
      NEXT I
3850  GOSUB 4100:
      NEXT J:
      RETURN
```

These are the seven different border patterns which may be formed to satisfy the symmetrical relationships. Having programmed these, the next step would be to add translation parallel to a second direction thus forming the plane patterns satisfying the same rules of symmetry.

REFLECTIONS

Program Listing

```
5  DIM X(88),Y(88)
10  HOME : VTAB 6: HTAB 9: PRINT "**********************"
11  HTAB 9: PRINT "*                    *"
12  HTAB 9: PRINT "*       STRIP        *"
13  HTAB 9: PRINT "*                    *"
14  HTAB 9: PRINT "*     PATTERNS       *"
16  HTAB 9: PRINT "*   G.H.GALLAGHER    *"
17  HTAB 9: PRINT "*       1982         *"
18  HTAB 9: PRINT "*                    *"
19  HTAB 9: PRINT "**********************"
25  FOR I = 1 TO 1000: NEXT I
30  HOME : VTAB 3: PRINT "       THE TRANSFORMATIONS OF"
40  VTAB 5: PRINT "REFLECTION AND ROTATION LINKED WITH"
50  VTAB 7: PRINT "TRANSLATION PARALLEL TO ONE DIRECTION"
60  VTAB 9: PRINT "FORM 7 DIFFERENT INFINITE STRIP"
70  VTAB 11: PRINT "OR RIBBON PATTERNS"
75  GOSUB 4000
80  HOME : PRINT "TYPE 1 TO SEE A SET OF EXAMPLES"
82  VTAB 3: PRINT "TYPE 2 TO FORM YOUR OWN DESIGN"
84  INPUT A: IF (A - 1) * (A - 2) <  > 0 THEN 84
86  ON A GOTO 120,500
100  DATA 1,1,2,1,3,1,4,1,5,1,5,2,5,3,5,4,5,5,4,5,3,5,2,5,1,5,1,4,1,3,1,2,
    2,2,3,2,4,2,4,3,3,3,3,3,2,4,3,4,4,4
110  DATA 5,6,6,6,7,6,8,6,8,7,7,7,6,7,5,7,5,8,6,8,7,8,8,8,8,9,7,9,6,9,5,9
115  DATA 8,10,9,10,10,10,10,11,9,11,8,11,8,12,9,12,10,12,10,13,11,14,11,1
    3,12,15,13,15,14,15,15,15,16,15,16,16,15,16,14,16,13,16,12,16,15,14,1
    6,14,16,13
116  DATA 11,13
120 X =  FRE (0):N = 67
130  FOR I = 1 TO N: READ X(I),Y(I): NEXT I
140  HOME : VTAB 21: PRINT "THIS IS THE BASIC ELEMENT"
141  GOSUB 2000
143  FOR I = 1 TO 2000: NEXT I
145  GOSUB 4000
150  HOME : VTAB 21: PRINT "THIS IS THE BASIC ELEMENT REFLECTED"
152  PRINT "IN A VERTICAL AXIS"
155  GOSUB 2100
160  FOR I = 1 TO 2000: NEXT I
165  GOSUB 4000
170  HOME : VTAB 21: PRINT "THIS IS THE BASIC ELEMENT REFLECTED"
172  PRINT "IN A HORIZONTAL AXIS"
180  GOSUB 2200
181  FOR I = 1 TO 2000: NEXT I
185  GOSUB 4000
190  HOME : VTAB 21: PRINT "THIS IS THE BASIC ELEMENT REFLECTED"
192  PRINT "IN TWO AXES"
194  GOSUB 2300
196  FOR I = 1 TO 2000: NEXT I
198  GOSUB 4000
200  HOME : VTAB 21: PRINT "THIS IS THE BASIC ELEMENT ROTATED       THROUG
    H 180 DEGREES"
201  GOSUB 2400
205  FOR I = 1 TO 2000: NEXT I
206  GOSUB 4000
210  HOME : VTAB 21: PRINT "1. THE PATTERN FORMED BY TRANSLATION"
212  PRINT "OF THE BASIC ELEMENT"
220  GOSUB 2000: GOSUB 2500: GOSUB 4000
230  HOME : VTAB 21: PRINT "2.THE BASIC ELEMENT REFLECTED IN A"
232  PRINT "VERTICAL AXIS AND TRANSLATED"
240  GOSUB 2100: GOSUB 2700: GOSUB 4000
250  HOME : VTAB 21: PRINT "3.THE BASIC ELEMENT REFLECTED IN A "
252  PRINT "HORIZONTAL AXIS AND TRANSLATED"
260  GOSUB 2200: GOSUB 2900: GOSUB 4000
270  HOME : VTAB 21: PRINT "4.THE BASIC ELEMENT REFLECTED IN"
272  PRINT "BOTH AXES AND TRANSLATED"
280  GOSUB 2300: GOSUB 3100: GOSUB 4000
290  HOME : VTAB 21: PRINT "5.THE BASIC ELEMENT IN A GLIDE"
292  PRINT "REFLECTION"
300  GOSUB 2000: GOSUB 3300: GOSUB 4000
310  HOME : VTAB 21: PRINT "6.REFLECTION FOLLOWED BY A GLIDE"
312  PRINT "REFLECTION"
320  GOSUB 2100: GOSUB 3500: GOSUB 4000
330  HOME : VTAB 21: PRINT "7.THE BASIC ELEMENT ROTATED ABOUT A"
332  PRINT "POINT ON THE LINE OF TRANSLATION AND"
333  PRINT "THEN TRANSLATED"
340  GOSUB 2400: GOSUB 3700: GOSUB 4000
350  TEXT : HOME : PRINT "TYPE 1 TO SEE THE EXAMPLE AGAIN"
360  PRINT "TYPE 2 TO MAKE YOUR OWN BASIC ELEMENT"
370  PRINT "TYPE 3 TO FINISH": INPUT A: IF (A - 1) * (A - 2) * (A - 3) <  >
    0 THEN 350
380  ON A GOTO 120,500,1000
500  HOME
501  PRINT "1,1                  16,1"
505  PRINT "   ****************"
506  PRINT "   ****************"
507  PRINT "   *************O**  THE O IS AT 14,3"
510  PRINT "   ****************"
515  PRINT "   ****************"
517  PRINT "   ****************"
520  PRINT "   ****************"
522  PRINT "   ****************"
525  PRINT "   ****************"
527  PRINT "   ****************"
530  PRINT "   ****************"
531  PRINT "   ****************"
532  PRINT "   ****************"
533  PRINT "   ****************"
535  PRINT "   **********S*****   THE S IS AT 11,15"
540  PRINT "   ****************"
555  PRINT "1,16                 16,16"
556 I = 1
560  VTAB 21: PRINT "A POINT,PLEASE,IN THE FORM A,B"
562  PRINT "TYPE 0,0 WHEN YOUR LIST IS COMPLETE"
563  INPUT A,B:C = B + 1:D = A + 3
564  IF A = 0 AND B = 0 THEN  GOTO 590
568 X(I) = A:Y(I) = B: VTAB C: HTAB D: PRINT ":"
570 I = I + 1: IF I > 88 THEN 585
580  GOTO 560
585  HOME : PRINT "THERE IS A MAXIMUM NUMBER OF POINTS(88).YOUR PATTERN IS
     ASSUMED TO BE COMPLETE"
590 N = I - 1: GOTO 140
1000  END
2000  HGR : HCOLOR= 3: FOR I = 1 TO N:P = 100 + X(I):Q = 40 + Y(I): HPLOT
    P,Q: NEXT : RETURN
2100  HGR : HCOLOR= 3: FOR I = 1 TO N:P1 = 100 + X(I):Q1 = 40 + Y(I):P2 =
    133 - X(I):Q2 = Q1: HPLOT P1,Q1: HPLOT P2,Q2: NEXT : RETURN
2200  HGR : HCOLOR= 3: FOR I = 1 TO N:P1 = 100 + X(I):Q1 = 40 + Y(I):P2 =
    P1:Q2 = 73 - Y(I): HPLOT P1,Q1: HPLOT P2,Q2: NEXT I: RETURN
2300  HGR : HCOLOR= 3: FOR I = 1 TO N:P1 = 100 + X(I):Q1 = 40 + Y(I):P2 =
    133 - X(I):Q2 = Q1:P3 = P1:Q3 = 73 - Y(I):P4 = P2:Q4 = Q3: HPLOT P1,Q
    1
2310  HPLOT P2,Q2: HPLOT P3,Q3: HPLOT P4,Q4: NEXT I: RETURN
2400  HGR : HCOLOR= 3: FOR I = 1 TO N:P1 = 100 + X(I):Q1 = 40 + Y(I):P2 =
    133 - X(I):Q2 = 73 - Y(I): HPLOT P1,Q1: HPLOT P2,Q2: NEXT I: RETURN
2500  FOR K = 1 TO 270 STEP 2: HPLOT K,100: NEXT K
2520  FOR J = 0 TO 7: FOR I = 1 TO N:P = J * 30 + X(I):Q = 84 + Y(I): HPLOT
    P,Q: NEXT I
2560  GOSUB 4100: NEXT J
2570  HCOLOR= 0: FOR K = 1 TO 270: HPLOT K,100: NEXT K: RETURN
2700  FOR J = 0 TO 6: FOR I = 1 TO N:P1 = J * 35 + X(I):Q1 = 84 + Y(I):P2 =
    J * 35 + 33 - X(I):Q2 = Q1: HPLOT P1,Q1: HPLOT P2,Q2: NEXT I
2800  GOSUB 4100: NEXT J: RETURN
2900  FOR J = 0 TO 6: FOR I = 1 TO N:P1 = J * 35 + X(I):Q1 = 84 + Y(I):P2 =
    P1:Q2 = 117 - Y(I): HPLOT P1,Q1: HPLOT P2,Q2: NEXT I
3000  GOSUB 4100: NEXT J: RETURN
3100  FOR J = 0 TO 6: FOR I = 1 TO N:P1 = J * 35 + X(I):Q1 = 84 + Y(I):P2 =
    P1:Q2 = 117 - Y(I):P3 = J * 35 + 33 - X(I):Q3 = Q1:P4 = P3:Q4 = Q2
3170  HPLOT P1,Q1: HPLOT P2,Q2: HPLOT P3,Q3: HPLOT P4,Q4: NEXT I
3250  GOSUB 4100: NEXT J: RETURN
3300  FOR J = 0 TO 5: FOR I = 1 TO N:P1 = J * 40 + X(I):Q1 = 84 + Y(I): HPLOT
    P1,Q1: NEXT I
3400  FOR I = 1 TO N:P2 = J * 40 + X(I) + 20:Q2 = 117 - Y(I): HPLOT P2,Q2:
     NEXT I
3410 P2 = J * 40 + X(I) + 20:Q2 = 117 - Y(I)
3450  GOSUB 4100: NEXT J: RETURN
3500  FOR J = 0 TO 5: FOR I = 1 TO N:P1 = J * 40 + X(I):Q1 = 84 + Y(I):P2 =
    J * 40 + 33 - X(I):Q2 = Q1: HPLOT P1,Q1: HPLOT P2,Q2: NEXT I
3580  FOR I = 1 TO N:P3 = J * 40 + 20 + X(I):Q3 = 117 - Y(I):P4 = J * 40 +
    20 + 33 - X(I):Q4 = Q3: HPLOT P3,Q3: HPLOT P4,Q4: NEXT I
3635  GOSUB 4100: NEXT J: RETURN
3700  FOR J = 0 TO 5: FOR I = 1 TO N:P1 = J * 40 + X(I):Q1 = 84 + Y(I): HPLOT
    P1,Q1: NEXT I
3800  FOR I = 1 TO N:P2 = J * 40 + 33 - X(I):Q2 = 117 - Y(I): HPLOT P2,Q2:
     NEXT I
3850  GOSUB 4100: NEXT J: RETURN
4000  VTAB 23: PRINT "PRESS ANY KEY WHEN YOU ARE READY TO"
4010  PRINT "CONTINUE                              "
4011  PRINT "                                      "
4020  GET A$: IF A$ = "" THEN  GOTO 4020
4030  RETURN
4100  FOR B = 1 TO 10:S =  PEEK ( - 16336): NEXT B: RETURN
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OSBORNE REVIEWED

Mike James

After years of writing books on computers and passing comments on the industry's behaviour, Adam Osborne has finally taken the plunge and produced his own portable micro. At the time of reviewing, it was 'selling like hot cakes' on the American market and just beginning to make itself felt in the UK. As to how it fared with our reviewer. . .read on.

Adam Osborne is a name that might be familiar to you if you're an avid reader of technical books. Back in the dark and terrible days, before CT was even a twinkle in anyone's editorial eye, information on microprocessors was very hard to come by. One much valued source was a series of paperbacks with the general title of 'An Introduction to Microcomputers'. At the time, these volumes were well thought of but looking back they seem very uninspired, especially when compared to the typical micro book published today. However, the series was a success, perhaps because we knew no better or perhaps because there were so few competitors.

The success of the series was also Osborne's success because he not only wrote them but published them as well and Osborne Associates grew into a publishing house with a worldwide reputation — so much so that about a year or so ago, McGraw-Hill bought Osborne Associates and are now using the name Osborne to endorse their own products!

There is little doubt that much of the success of Osborne's publishing venture was due to him doing the right thing at just the right time. And now he has founded a new venture, the Osborne Computer Corporation, and introduced a new computer, the Osborne 1. As it is based on comparatively old technology (ie the Z80 and 5¼" floppy discs) and with the flood of new 16-bit machines just about to start, the question must be — has Osborne got his timing right this time? For, if the machine is to be a success, it has to fill a gap in the market no one else has spotted.

An Overview

The specification of the Osborne 1 is that of a fairly standard mid-range computer system — Z80 CPU, 64K of RAM and dual 5¼" discs. What is not standard about the Osborne is the way these fairly standard items have been packaged into a small suitcase-sized unit. Much of the advertising literature shows the machine being carried about as if it were no heavier (and no more exciting?) than a normal briefcase.

In reality the Osborne 1 is a little heavier than a normal briefcase but its size and weight by no means rule out carrying it around with you. I found that the problems started when you try to put it down for a short rest. The bottom of the case

slopes back at about five degrees, which is ideal when it is being used as the keyboard (see later) but as a base for the whole machine it produces an unpleasant tilt.

Another problem with carrying the machine around with you is the 13 A plug. On top of the case next to the carrying handle is a small recess covered by a piece of metal held in place by 'Velcro'-type strips of cloth. In the States this recess contains the mains lead *and* the smallish 110 V three-pin plug. In the UK, however, things don't work quite so well — our 240 V three-pin plug is much too big to fit inside this recess and the only sensible thing to do is to leave it hanging outside. The trouble with this solution is the Velcro strips are not strong enough to hold the cover in place if the plug catches on anything. In fact, on several occasions when I was carrying the Osborne 1 about, the cover jumped off without any obvious provocation. So, if you want to avoid the embarrassment of replacing the mains cable and picking up the cover in the street, you'll have to find some other method of holding the lead in place. (**It appears that this problem will be removed by the introduction of an IEC plug/socket combination which will make the power lead removable. Ed**)

I may, however, have the wrong idea of how the Osborne is supposed to get from one place to another. The advertising literature says 'Case — The plastic case snaps together to form a weatherproof package which fits underneath the standard airline seat'. I have not had the courage to test the weatherproof part of the claim and as the complimentary airline tickets haven't arrived yet, I cannot comment on the second claim!

When you have carried the Osborne to its destination then unpacking it ready for use is very easy. Unclipping the bottom of the machine reveals the disc drives, TV screen, sockets and controls. The bottom transforms itself into a full sized keyboard and optional prop for the front of the machine. All you have to do from this point to be up and running CP/M is to plug the machine in, switch on and place the operating system disc in drive A!

There are two slots in the front of the machine, one under each disc drive, which the advertising literature suggests can be used for storing up to 25 diskettes. If you follow this suggestion you don't have to carry *another* briefcase containing diskettes! However, I'm not sure how wise it would be to leave diskettes in the storage slots when the machine was in use simply because of the risk of stray magnetic fields from the disc drives or elsewhere (especially in view of the lack of shielding — see later) causing disc errors.

Above: The keyboard is encased in the lid of the carrying case and can be completely detached. Nothing terribly special here as far as extra keys are concerned.

Right: The case leans at an alarming angle due to the sloped keyboard enclosure but is not too unstable. The mains lead cover is one of the weaker design features.

Top right: Close up on the front panel reveals the generous provision of I/O sockets. The two deep slots are for disc storage but this is not recommended as there is little shielding provided from the power supply.

Once you've set the system up and are using an applications package or whatever, the only real difference between the Osborne 1 and any other computer is the screen size. The Osborne 1 has a 5" display mounted between the disc drives, and although this gives a sharp and stable image, the actual size of each letter is *very* small indeed. Obviously on a 5" screen there is no way you can achieve a standard commercial 24 lines of 80 characters which is more than I would have thought possible on so small a screen. This is such an important design difference that before you decide on an Osborne 1, it is imperative you check that the small screen size is acceptable to you — it would be a shame to own a machine which did everything right except let you see the answers! (**The current brochures indicate that an external 12" monitor is available. Although we were given one for photography we now understand this product has been withdrawn from the UK market. The replacement will be an adaptor to allow the Osborne to connect to a standard monitor or TV set which will make it much more 'portable' — with the special monitor, you had to carry that round as well! Ed**)

Another side-effect of the small screen is that although *you* may be able to work with the machine, any ideas that you (or the Osborne Computer Company) may have about using it for business demonstrations, sales pitches, etc are going to be a little more difficult than with a conventional machine. The fanciful scene of someone walking into an office carrying an Osborne 1, setting it up and amazing the boss with how fast all the information is available from the machine is more likely to end in an argument about what information was actually on the screen!

Seriously though, the difficulties of showing other people what's being displayed on such a small screen should be kept in mind when evaluating the Osborne 1. Also, I can't really recommend it for long word processing sessions. You might be willing to tolerate the small character size but remember, you are enthusiastic about computers (you bought one didn't you) but this is not the natural state of the rest of the population — so have a care

when asking anyone else to word process on your behalf.

Apart from the small character size, there is also the problem that most commercial applications packages expect to find a screen size at least 24 lines by 80 characters. The result of running such a package on a smaller screen is that all the nice formatting and layout which took the programmer so long to do is destroyed. However, the Osborne 1 avoids this problem by using the screen display as no more than a 'window' onto a much larger internal screen. The internal screen is 32 rows by 128 characters wide — an exceptionally large display for a micro. You can move the smaller window around the big display using the normal editing keys. So if a program produces an output with a long line length, you can see all of it by moving the display to the right and left as required. Similarly, you can move the window up and down.

There is also the option of having the window move automatically when you are typing in. If you move the cursor to a position off the edge of the displayed portion of the internal screen, the window is automatically moved allowing you to see what you are typing.

There is no doubt everything possible has been done to overcome the problems of a small screen but it is still a restriction. You could get over the small character size by using an external monitor but there appears to be no simple way of increasing the number of characters displayed on a line.

In most other respects the Osborne 1 behaves much like any other CP/M-based machine. Some notable good points are: the provision of programmable function keys; the provision (as standard) of a serial and an IEEE-488/Centronics interface; and some extra software to make CP/M more bearable! The keyboard is a good quality one with a keypad to the right, auto repeat on all keys and an alpha lock. The keyboard is connected to the rest of the machine by a short ribbon cable so although it is detached, the amount of movement is limited.

The discs hold a total of 102K each, so you don't have that much to play with after the systems software has taken its share. I would describe 100K as workable but not generous! The advantage to be gained from this low amount of disc storage includes reduced cost and, to a small extent, increased reliability.

Technical Details

The Osborne 1 measures 12" high by 19.5" wide by 8.5" deep when closed and weighs a very modest 24lb! Its case is made from a thin cream-coloured plastic and comes in two parts — the keyboard and the main machine.

Access to the inside of the machine is via the front panel. If this is removed, the way the various components — disc drives, video monitor, etc — are supported and joined together can be seen. A thick strip of black plastic is shaped to hold the disc drives and the monitor at the correct height and the printed circuit board holding nearly all of the electronics is fixed underneath.

Undoing two screws on either side of the case allows the entire assembly to slide out. As soon as the hardware is out of its case it all seems very flimsy and mechanically weak. This is because the case and the internal hardware support each other. The case stops the internal hardware from moving and vice versa. So although the internal hardware can be removed very easily for servicing, it must be handled with care to avoid damage to the main PCB.

The disc drives to either side of the video monitor appear to be completely enclosed by aluminium shielding but in fact, the bottom is unshielded. The purpose of the shielding is a little unclear but it is probably to reduce the effect of the drive motors on the monitor's picture quality. The drives themselves are (in the review model at least) MPI model 51s. As I have no long-term experience of this make, I cannot comment on its reliability but the quality of manufacture seems high. A steel belt is used to position the head and the electronics looks simple and well produced. After comparing the speed of file access with that of other micros I would also think that the head step time is smaller than average — giving the Osborne 1 a slight speed advantage on disc operations.

The video monitor is a standard (Japanese) unit and, as mentioned earlier, the picture quality is very good indeed. On the review model however, the contrast was always at MAX and there was very little leeway on the brilliance control.

The power supply is mounted on its own PCB to the rear of the main PCB. From a brief examination it is almost certainly a switched mode supply. There is no large power transformer in the Osborne 1 and hence less weight and less heat. There is little ventilation provided but what there is seems adequate.

The main PCB contains the rest of the electronics, the CPU, RAM, ROM, I/O chips and floppy disc controller. The quality of construction is good although the PCB is a little on the thin side for a board of this size and I would like to have seen it better supported. The overall layout is professional but there are plenty of very thin copper tracks everywhere which might prove difficult if a chip had to be replaced. But these are minor points. There is no sign of any last-minute modifications by way of cut copper tracks or jumper wires.

On the far right of the main PCB there are four rows of eight 4116 dynamic RAM chips forming the 64K of main memory. Sitting a little to the left of the main memory block is a single 4116 all on its own. This is the 4K by 1 bit video attribute memory which lives in Memory Bank Three, but more of this later. Moving across to the middle of the board we find two socketed EPROMs. The first is a 2K 2716 used as the character generator; this allows customised character sets to be generated. The second is a 4K 2732 holding the system program. The Z80A in the middle of the board is also socketed and is a double speed (4 MHz) device.

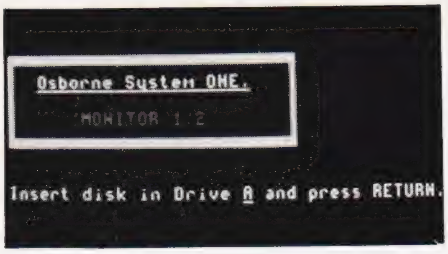
The only real surprise in the Osborne's hardware is found when the other big chips in the system are examined. Three I/O chips made by Motorola are used in preference to the more usual Intel or Zilog parts. There is a sort of unwritten (and unnecessary) rule that you don't mix Intel/Zilog systems with Motorola parts. The reason is that 8080/Z80 programmers are used to the INP/OUT instruction and Motorola I/O chips are all memory mapped.

With 64K of main memory there isn't any address space left over to allocate to I/O ports. The solution

Right: The somewhat complicated memory map. See the text for further details.

Far right: The Osborne revealed. The internal construction is certainly not one of the best seen!

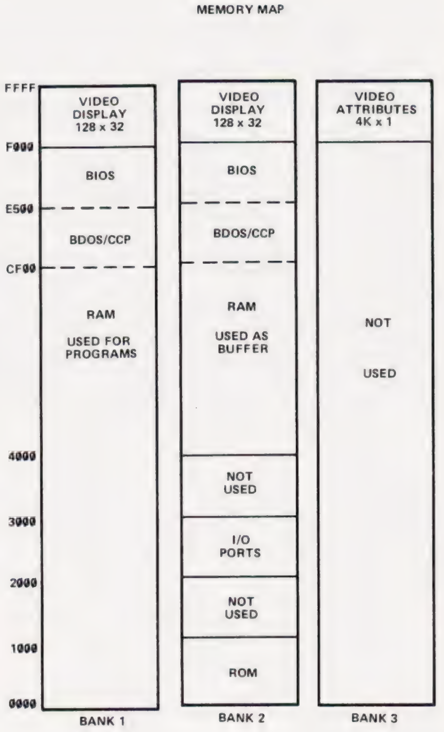
Below: The welcoming message on power-up. The only problem is that the drives aren't labelled!



used by the Osborne 1 is to put the I/O ports into a second memory bank. This, at first sight, seems like a very reasonable solution, but the trouble with bank switching is that it is a slow and clumsy way of increasing address space. Both the Z80 and the 8080 have an extra 256 bytes of address space available via the INP/OUT instruction pair and it would have been more sensible to place the Motorola I/O chips as I/O ports. The only minor disadvantage of doing this would have been the restriction in the range of instructions to access the data and control registers. This change wouldn't have got rid of Memory Bank Two altogether because the system EPROM lives there, but it would have allowed the I/O chips to be accessed from any memory bank.

The actual I/O chips used are two 6821 PIAs — one is used for the IEEE-488/Centronics interface and the other is used to control the video display and one 6850 ACIA (used to provide the RS 232 serial interface). The only other large chip in the machine is a 1793 disc controller and the same comments concerning memory mapping can be applied to this device.

The absence of any mention of a large chip CRT controller should have alerted you to the fact that the Osborne 1 uses standard TTL chips to generate the video signal from the top 4K of main memory. Not very much information is available about how this is done or what the 6821 PIA has to do with it all, but it would be a good guess to say the video display was carried out in between Z80 memory accesses and that the PIA has something to do with the area of memory actually displayed. The character generator includes 32 graphics characters but as these have been assigned the same ASCII

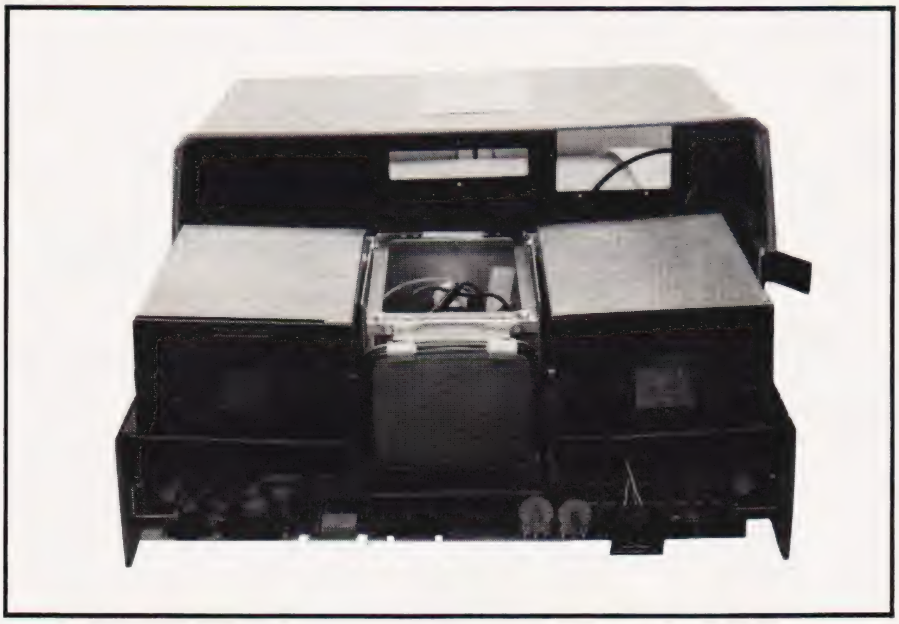


codes as the cursor controls it is only possible to go in for moving graphics from assembly language. There is also a half brightness display mode which can be switched on by setting the appropriate bit in the video attribute memory in Bank Three.

The final I/O device is the keyboard and this too avoids the use of a large chip. Instead, the encoding is done by software and there are eight memory locations used to show which keys are pressed.

The Memory Map

The Osborne 1's memory map is quite complicated for what is otherwise a simple computer! As has already been mentioned, there are three memory banks. The first is simply 64K of dynamic RAM used for CP/M user programs and the 4K video display. As CP/M uses about 18K, user programs have 52K all to themselves — an unusually large amount of free RAM for a system using memory mapped video. The price paid for this free memory is that the system ROM is located in a second memory bank along with all the I/O devices. Switching between memory banks is carried out by outputting to an I/O port and writing to a fixed memory location. As two operations are required, switching is not as fast as it might be. The memory from $4000 upward is shared by Bank One and Bank Two so you have to be careful when us-



ing the memory from one in case it is already in use from the other.

There is an obvious problem using the disc which is caused by this memory arrangement. Suppose you have a program running in the first 16K of memory which wants to read a record from the disc. It calls CP/M to look after its request and CP/M switches to Bank Two to gain access to the disc controller. CP/M is still present in Bank Two because it uses memory above $4000 and thus can send the necessary commands to the disc controller to read the record. The program that requested the data isn't so lucky. It lives below $4000 so it is ***not*** present in Bank Two and CP/M cannot transfer data directly to it! What CP/M has to do is first read the data to a buffer high in memory then switch back to Bank One and move the data down to where it is required. The reverse process occurs in a program trying to write data from a buffer (FCB in CP/M terminology) located below $4000.

The transfer buffer is reserved as part of the Osborne CP/M implementation and the user need not worry about it, but its use does slow things down just a little.

The only other detail about the memory map is that there is a third bank. This bank contains only a 4K by 1 bit video attribute memory which sets the high or low brightness display mode for any character stored in the corresponding address in Banks One and Two.

Free Software!

The Osborne 1 is a CP/M machine and that should tell you a lot about its software. Either you like CP/M or you don't, but there is no avoiding the fact that CP/M is an industry 'standard' operating system. The Osborne is fairly unique in including a range of system and applications software in its price. As well as CP/M you get Wordstar and Mailmerge, Supercalc, CBASIC and MBASIC. The inclusion of a word processor and a business calculator indicate the sort of use the Osborne 1 is intended for. The provision of MBASIC and CBASIC may seem like overkill but in fact is very sensible. A wide range of business software is available in compiled form running under CBASIC. MBASIC, however, is a fast easy-to-use interpreter suitable for program development.

In addition to these large items of software there is also a HELP program to teach you some simple things about the machine, a disc copying program, a disc formatting program, a setup program to configure the machine and an extended directory command. All of these are useful and make life with CP/M a little more bearable.

Documentation

With Osborne's track record in publishing, you would expect the manual accompanying his first computer to be good. It is! (By the standards of other computer manuals, that is.) The ring-bound manual includes a 'getting started section' and something readable on each of the supplied programs. There is always room for improvement and more information, indeed the manual suggests **The Osborne CP/M User Guide** published by Osborne/McGraw-Hill as a supplement! Perhaps the entire Osborne publishing output has always been intended as a gigantic computer manual?

Expansion And Development

There is not much that can be done to expand the Osborne 1 in the traditional sense — it already has two disc drives and 64K of memory. There is no expansion bus to be found anywhere on the machine and as the machine has no standard bus structure, you can forget using other peoples' add-ons. In short there is not much you can do to change the Osborne 1 into something else. Having said this it should be pointed out that an IEEE-488 port is standard and should provide at least one way of connecting exotic peripherals such as hard discs, graph plotters, voltmeters, etc.

As for future developments — Osborne promises a 1-2 hour life battery pack and a special modem unit. Future versions of the Osborne 1 are planned to use double density discs and an 80 column screen (sometime in 1982). Certainly the increase to 80 columns would be a major improvement!

Conclusions

The Osborne is certainly capable of being used in ways other machines cannot. It's cheap and portable and I am sure this is enough to make sure that it sells. If it is enough to make it sell as many as Osborne predict it will is another question. If you want an all-in-one business system then there are a number of standard CP/M systems you can choose from — the SuperBrain and the Tandy Model III to name just two — which do not suffer from the tiny screen problem. I am of the opinion that the market for a portable, complete business computer is just not as great as Osborne thinks — but I suppose he has done his market research!

A less obvious area where I think the machine might be popular is as a cheap scientific machine. Because it's small, light and cheap and has an IEEE-488 instrumentation bus I can imagine it being used in a wide range of lab situations where the screen size is of far less importance (see the HP-83/85 systems for evidence of this).

All-in-all, I think the last word should go to the Osborne 1's own manual — 'The hardware of the Osborne 1 is of the plain vanilla variety'.

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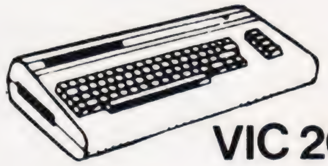

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uter-

G Phillips

If your micro only squeals when you thump it in frustration then you obviously haven't got a sound board! We examine a dedicated board for the Tangerine system.

Despite the apparent popularity of the range of micros from Tangerine, relatively few companies seem to be offering hardware add-ons. One exception to this state of affairs is the Sound Board from Bulldog Video. The company itself is somewhat of an exception too, being run by a couple of ex-ICL computer staff — the mainframe making good perhaps?

The board is designed to plug directly into the backplane of a rack-based Tangerine system and is fully self-contained. For the price of £45 you get the board with one sound chip (the GI AY-3-8910), a second chip is optional; an on-board amplifier (or you can connect it to your own); facilities for two I/O ports and a set of documentation.

Better Read

Setting up the board could hardly be easier, just open the front of your rack, find a vacant slot on the backplane and plug it in; it's wise to make sure that the power is *off* when you do this!

Turning to the first of the three booklets, the User Manual, the logical place to start is at the beginning where the new owner is gently led through the procedures involved in generating some simple sounds. Much of the simple programming is given in machine code, but reference is made to BASIC and examples are given together with some useful tables.

The section concludes with some notes on the shape of sound (piano notes are used to illustrate the various sound shapes) and a very useful frequency table.

Although the board is designed in such a way that you can use the two ports as general purpose I/O, there is no documentation on the pin layout of the socket. However, a small amount of detective work with the GI manual on the sound chip and a multimeter produced the results given in Table 1. These ports are accessed through registers 14 and 15 of the sound chip and are TTL compatible; the GI manual is of some help here too.

The two pieces of GI documentation supplied are the chip manual, useful but all the values are given in Octal; and a data sheet on the device also not particularly useful. One word of warning about the chip manual — the examples given will not work as shown because they are based on a different clock frequency to that used by the Tangerine.

Wired For Sound

The Sound Board is a memory mapped device and is controlled by two addresses, BC00 and BC01 Hex (four if you have the optional second chip). The actual internal functions of the device are selected by 16 internal registers which can be individually updated.

To select any given register, the register number is written to address BC00 Hex (48128) and the new value is written to address BC01 Hex (48129). Similarly, the contents of any register may be checked by addressing it and reading the value. The second sound chip works in exactly the same way but uses locations BC02 and BC03 Hex.

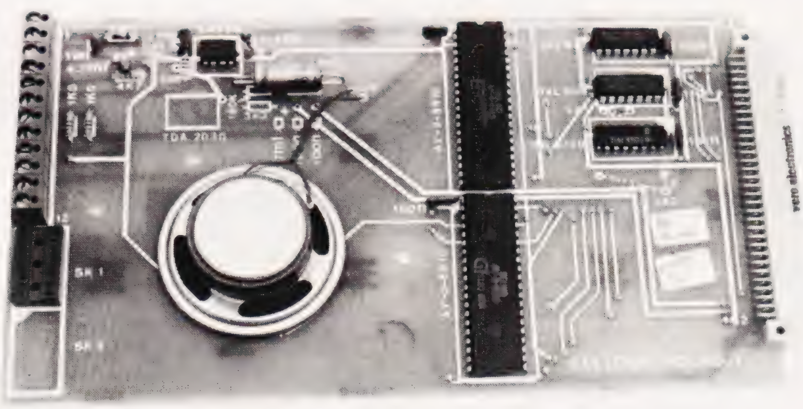
The three major features of the GI chip are:

1) Three tone channels
2) A white noise generator able to mix with any of the three tones
3) An amplitude controller linked to the envelope generator.

This last feature allows you to turn a single boring tone into something interesting, well almost . . . there are only eight different envelopes available and the controller acts on all three tones and the white noise. Still, the Sound Board does bark better than it bytes!

To program in the required effect, one simply has to set up certain registers with the necessary values. However, unless you want a continuous tone or sound you may have to alter up to 13 registers for each required note; machine code is likely to prove useful here.

Probably the best way to demonstrate the features is by giving some example programs. The first gives a gunshot each time a key is pressed.



The Bulldog Video soundboard. This version is equipped with two of the GI devices, the second chip is optional.

```
 10  REM ** GUNSHOT
 19  REM ** SET ADDRESSES
 20  A=48128:B=48129
 29  REM ** SELECT FREQUENCY
 30  POKE A,6:POKE B,9
 39  REM ** NOISE ON ALL CHANNELS
 40  POKE A,7:POKE B,7
 49  REM ** SELECT ENVELOPE
 50  POKE A,8:POKE B,16
 60  POKE A,9:POKE B,16
 70  POKE A,10:POKE B,16
 79  REM ** SELECT ENVELOPE LENGTH
 80  POKE A,12:POKE B,4
 89  REM ** HIT KEY TO TRIGGER
 90  GET A$
100  POKE A,13:POKE B,0
110  GOTO 90
```

By amending the length of the envelope we can use the same basic functions to generate an explosion.

```
 10  REM ** EXPLOSION
 19  REM ** SET ADDRESSES
 20  A=48128:B=48129
 29  REM ** SELECT FREQUENCY
 30  POKE A,6:POKE B,11
 39  REM ** NOISE ON ALL CHANNELS
 40  POKE A,7:POKE B,7
 49  REM ** SELECT ENVELOPE
 50  POKE A,8:POKE B,16
 60  POKE A,9:POKE B,16
 70  POKE A,10:POKE B,16
 79  REM ** SELECT ENVELOPE LENGTH
 80  POKE A,12:POKE B,32
 89  REM ** HIT KEY TO TRIGGER
 90  GET A$
100  POKE A,13:POKE B,0
110  GOTO 90
```

One significant advantage of using a sound generator is that once you have set up the effect it is instantly available. More complicated effects, however, require loops and delays — the next example produces a whistling bomb and could be followed by the explosion just generated.

```
 10  REM ** WHISTLING BOMB
 19  REM ** SET ADDRESSES
 20  A=48128:B=48129
 29  REM ** SELECT ONE TONE
 30  POKE A,7:POKE B,62
 39  REM ** HIT KEY TO TRIGGER
 40  GET A$
 50  POKE A,8:POKE B,15
 60  FOR S=25 TO 200
 70  GOSUB 120
 80  POKE A,0:POKE B,S
 90  NEXT S
100  POKE A,8:POKE B,0
110  GOTO 40
119  REM ** DELAY
120  FOR D=1 TO 5
130  NEXT D
140  RETURN
```

In a similar vein this example produces the familiar 'zap' effect for those space games.

```
 10  REM ** SPACE ZAP
 19  REM ** SET ADDRESSES
 20  A=48128:B=48129
 29  REM ** SELECT ONE TONE
 30  POKE A,7:POKE B,62
 39  REM ** HIT KEY TO TRIGGER
 40  GET A$
 50  POKE A,8:POKE B,15
 60  FOR S=10 TO 44
 70  POKE A,0:POKE B,S
 80  NEXT S
 90  POKE A,8:POKE B,0
100  GOTO 40
```

As a final example, here is a very simple organ program producing quite pleasing tones as keys 0 to 9 are pressed. It may not exactly be Beethoven but it does illustrate the principle!

```
 10  REM ** TAN PIANO
 19  REM ** SET ADDRESSES
 20  A=48128:B=48129
 30  DEF FNA(X)=INT(X/256)
 40  DEF FNB(X)=X-FNA(X)*256
 50  DIM A(10)
 60  DATA 358,318,284,268,240,214,
     190,180,158,142
 70  FOR L=0 TO 9
 80  READ A(L)
 90  NEXT L
100  POKE A,7:POKE B,248
110  POKE A,8:POKE B,16
120  POKE A,9:POKE B,16
130  POKE A,10:POKE B,16
140  POKE A,11:POKE B,80
150  POKE A,12:POKE B,7
160  GET K
170  K1=A(K):K2=K1/2:K3=K1/4
180  POKE A,0:POKE B,FNB(K1)
190  POKE A,1:POKE B,FNA(K1)
200  POKE A,2:POKE B,FNB(K2)
210  POKE A,3:POKE B,FNA(K2)
220  POKE A,4:POKE B,FNB(K3)
230  POKE A,5:POKE B,FNA(K3)
240  POKE A,13:POKE B,0
250  GOTO 160
```

Usage and Abusage

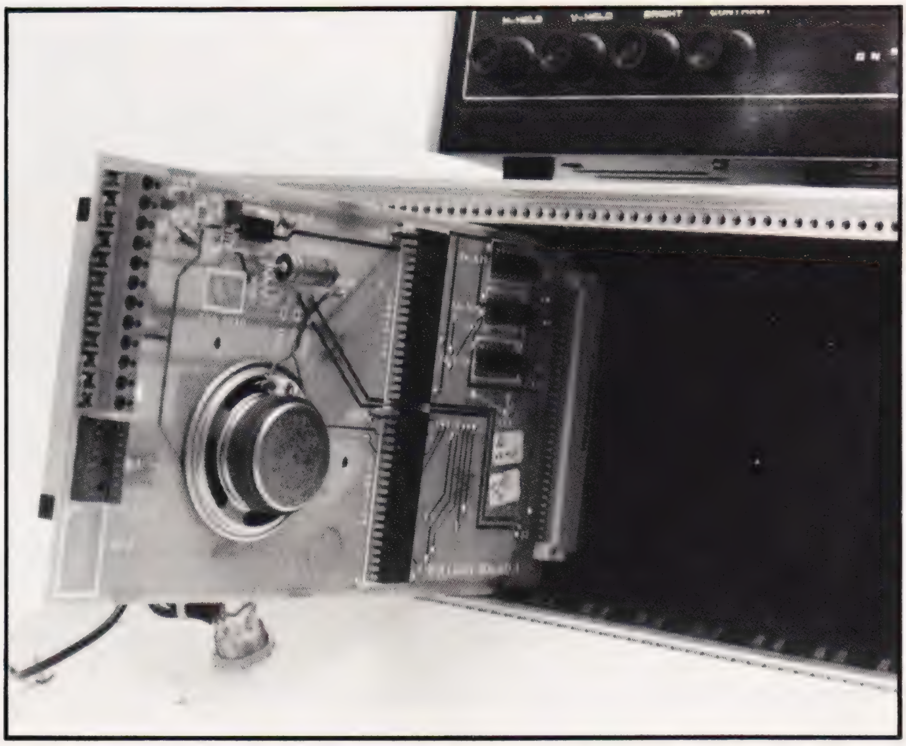
One of the major questions about a product such as this is 'what can I do with it?'. Well, you could incorporate it into a serious program to act as a warning device alerting you that some process has failed or that a given number of functions have been performed. It has obvious applications in games programs, especially those of an interactive nature. You could even use it to provide feedback to the user, key clicks in a word processor program for example.

Pin	Port	Bit
1	B	6
2	B	4
3	B	2
4	B	0
5	A	6
6	A	4
7	A	2
8	A	0
9	A	1
10	A	3
11	A	5
12	A	7
13	B	1
14	B	3
15	B	5
16	B	7

Table 1. The pin connections for the two I/O ports.

The provision of two I/O ports offers the facility to connect peripheral devices and the status of these could be monitored by the system with the option of audible warnings . . . perhaps the Bulldog could even become a watchdog?

In summary, therefore, the board is easy to use and simple to install but, as is so often the case, it is let down by inadequate documentation. However, if you want to add sound to your system then the Sound Board still seems to offer value for money.



Fitting it could hardly be easier. Drop the front panel of your rack (this is the Vero alternative) find a free slot and plug it in!

Paul Hodgkinson

PROGRAM PROTECTION

This simple method of protecting your programs from being copied may not be the most elaborate but it can certainly cause considerable frustration to the unauthorised user.

Despite recent advances in microcomputer technology, unauthorised copying of programs remains a seemingly insoluble problem. Most existing methods attempt to prevent a return to the command level thus making copying impossible. This is achieved by amending appropriate addresses in the machine by using POKE. Such systems are, of course, ineffective if the program is not run.

This technique, although not a complete solution, has certain attributes which make it very effective. No attempt is made to prevent a copy being made and this can be verified against the original; if the copy is loaded into the PET, it will run and the listing is identical. However, when the user returns at a later date with the copy and attempts to use it, the copy appears corrupted and will not run.

Creating Protected Copies

The technique listed here is suitable for use with 16K and 32K PETs.

1) Append an additional statement to the program to be protected. List the program and insert SYS 1000 near the beginning. Remember not to append it to a line which already contains a REMark statement because the entire content of a line following REM is ignored. Decimal 1000 is particularly suitable because it implies a small machine code subroutine resident in the second cassette buffer.

2) Determine the top of BASIC text. At this stage it is necessary to determine how long the program is. This is done by examining the pointer to the start of variables. Variables are stored in the RAM immediately following the BASIC text. Enter:

```
PRINT PEEK(43):PRINT PEEK(42)
```

When Return is pressed two figures will appear:

```
4
104
```

These are the high order byte and the low order byte, expressed in decimal, of the pointer to the start of variables. They must now be converted to a four-digit hexadecimal number. Remember Hex is base 16 and the figures 10 to 15 are substituted by A to F. For example, decimal 255 becomes FF and the example above, therefore, becomes 0468 Hex.

3) Enter the Machine Language Monitor (TIM). TIM is resident in 16K and 32K PETs but a cassette version is required for 8K models. Enter:

```
SYS 1024
```

When Return is pressed the monitor is entered and a display of registers will appear.

4) Display the contents of decimal 1000 (Hex 03E8). After the full stop, type:

```
M 03E8,03EF
```

When Return is pressed, the contents of the bytes from 03E8 Hex to 03EF Hex will be displayed on a single line as two-digit hexadecimal numbers starting with 03E8 Hex. If a '?' appears, the space between the M and the 0 of 03E8 Hex has been omitted. Although this is the standard format for using the monitor it seems designed to mislead! It is not the space that is important, any character can replace the space or comma without affecting the operation of the monitor.

5) Place the 6502 op-code 'Return from subroutine' in decimal 1000 (hexadecimal 03E8). Move the cursor up to the 03E8 Hex in front of the line of bytes previously displayed. Move across to the first two digit number, overtype it with 60 and press Return.

6) Save the program using the Machine Language Monitor (TIM). TIM is used because the start and end address can be specified and it is necessary to save the op-code in 03E8 Hex with the BASIC text. After the full stop, enter:

```
S "TITLE",01,03E8,0468
```

Where 'TITLE' is the program name, 01 is the device number to which the save is made (in this case the first cassette), 03E8 Hex is the start address and the last hexadecimal number (in this case 0468 Hex) is the figure previously calculated to be the top of BASIC text. The familiar 'PRESS PLAY AND RECORD ON TAPE 1' should appear when Return is pressed. Operate the cassette deck as normal. If '?' appears you have probably forgotten the space after the S.

7) Exit from the Machine Language Monitor is done by typing X and pressing Return. You now have a protected copy. The copy will load in the usual way because LOAD detects the start address placed on the tape header by TIM.

How It Works

The protected copy contains the contents of the bytes from 03E8 Hex upwards as well as the BASIC text. When the program is LOADed and RUN, SYS 1000 passes control to decimal 1000 (03E8 Hex). The op-code 60(RTS) immediately passes control back to BASIC and the program RUNs as normal.

If an unauthorised copy is made using SAVE, only the BASIC text from 1024 upwards is recorded — the vital op-code in 03E8 Hex is not included. If the unauthorised copy is loaded to check it is correct, it will run as expected. This is because 03E8 Hex is in a protected area of RAM and is unaffected by command level instructions. The op-code from the original copy will still remain to pass control back to BASIC, providing that the PET has not been switched off or the second cassette buffer used in the interim period.

When the user returns at a later date, the copy will LOAD but any attempt to RUN will cause the monitor to be entered followed by a break or a crash depending on the contents of 03E8 Hex at the time.

Conclusion

This technique offers a more subtle approach to program protection and attempts to confuse the copier rather than throw down a blatant challenge to defeat the protection.

It is readily adapted to operate on other microcomputers which have a flexible Cassette Operating System. Most manufacturers leave bytes unused in the reserved area of RAM.

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NAS DRAW

Pete Dann

You can certainly produce pictures on a screen, you may even be able to print them out but can you save them on tape? With this clever little utility you can!

This sketching program for the NASCOM allows easy composition of pictures from the pixels of the NAS-GRA graphics ROM and all available alphanumeric characters. It was written on a NASCOM 2 with the NAS-SYS 1 monitor and contains machine code subroutines (Listing 1); modifications to these subroutines will be required for other monitors.

The pictures are produced by using the 18 commands listed in Table 1 and can be stored on tape and recalled easily by any BASIC program. The examples shown here, some from an adventure program, were all drawn using this program.

```
Subroutine A (at ØDØØ Hex)

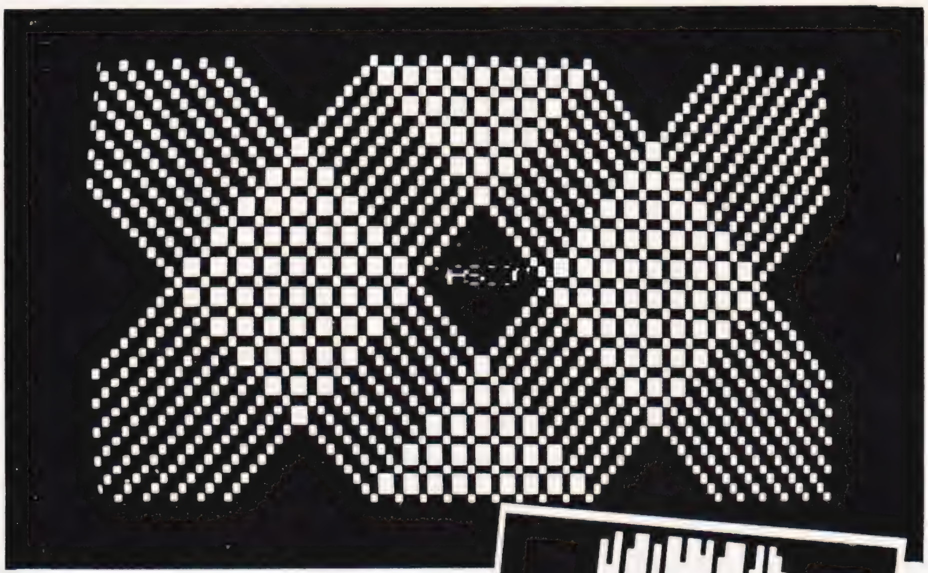
ØDØØ 21 Ø1 ØC          LD HL,ØCØ1
ØDØ3 Ø6 Ø9             LD B,9
ØDØ5 36 ØØ             LD (HL),Ø
ØDØ7 23                INC HL
ØDØ8 1Ø FB             DJNZ,ØDØ5
ØDØA DF 62             SCAL IN
ØDØC 38 Ø1             JR C,ØDØF
ØDØE AF                XOR A
ØDØF 47                LD B,A
ØD1Ø AF                XOR A
ØD11 2A ØD EØ          LD HL,(EØØD)
ØD14 E9                JP (HL)
ØD15 ØØ                NOP

Subroutine B (at ØD16 Hex)

ØD16 DF 7B             SCAL BLINK
ØD18 FE 2F             CP '/'
ØD1A 2Ø Ø1             JR NZ,ØD1D
ØD1C C9                RET
ØD1D F7                RST ROUT
ØD1E C3 16 ØD          JP ØD16
```

Listing 1. The two machine code routines.

On LOADing and RUNning the program, the user is presented with a blinking pixel cursor in the centre of the screen; this blinks continuously as a reminder of the current drawing position (CDP). The cursor can be moved horizontally or vertically by pressing the appropriate cursor control key and will continue to move as long as the key is held down. It can also be moved diagonally up or down by using the same keys whilst holding the 'CTRL' key down; the keys on the left move it up and left and down and left and those on the right move it up and right and down and right (see Table 1). Movement of the cursor is confined to the screen area by the program so there is no danger of 'going off the edges'!



Some examples of block graphics created using the NAS-GRA ROM. These designs can be stored on tape using the disc utility program.

COMMAND	ASCII CODE	ACTION
Moves:		
←	17	Move cursor left.
→	18	Move cursor right.
↑	19	Move cursor up.
↓	20	Move cursor down.
CTRL + ←	81	Move cursor down and left.
CTRL + →	82	Move cursor up and right.
CTRL + ↑	83	Move cursor up and left.
CTRL + ↓	84	Move cursor down and right.
Modes:		
D	68	Set DRAW mode.
M	77	Set MOVE mode.
E	69	Set ERASE mode.
C	67	Set CHARACTER mode.
Misc:		
'carriage-return' or 'cursor-home'	23	Position cursor at beginning of current line.
H (HOME)	72	Position cursor at top left of screen.
B (BLANK)	66	Clear screen and centre cursor.
L (LINE)	76	Clear current line.
P (PICTURE)	80	Save picture on tape.
/	47	End character mode or end program.

Table 1. The command table; the functions and their corresponding codes.

Program Listing

```
10   DIM PIC(720),AS(18)
19   REM ** LOAD MACHINE CODE SUBROUTINES
20   FOR L=3328 TO 3360 STEP 2
30   READ J:DOKE L,J:NEXT L
40   DOKE 4100,3328
50   FOR L=1 TO 18:READ AS(L):NEXT L
60   CLS:X=45:Y=18
69   REM ** SCAN KEYBOARD FOR INPUT
70   U=USR(0):IF U<>0 THEN GOSUB 110
79   REM ** BLINK IF NO INPUT FOUND
80   FOR L=1 TO 20:NEXT L:SET(X,Y)
90   FOR L=1 TO 20:NEXT L:RESET(X,Y)
100  GOTO 70
109  REM ** FIND INPUT IN AS()
110  FOR L=1 TO 18
120  IF U=AS(L) THEN U=L:GOTO 140
130  NEXT L
140  ON U GOTO 320,350,330,360,310,300
150  ON U-6 GOTO 290,340,180,200,190,240
160  ON U-12 GOTO 210,220,60,230,490,590
170  RETURN
179  REM ** SET DRAW, MOVE OR ERASE MODE
180  D=1:RETURN
190  D=-1:RETURN
200  D=0:RETURN
209  REM ** CARRIAGE RETURN, HOME & BLANK LINE
210  X=0:RETURN
220  X=0:Y=0:RETURN
230  SCREEN X/2+1,Y/3+1:PRINT CHR$(27):RETURN
239  REM ** SET CHARACTER MODE
240  DOKE 4100,3350:SCREEN X/2+1,Y/3+1
250  U=USR(0):FOR L=1 TO 2500:NEXT L
260  D0=0:D=0:DK=DEEK(3113)-1993
270  Y=INT(DK/64):X=(DK-64*Y)*2:Y=Y*3-2
280  DOKE 4100,3328:GOTO 440
289  REM ** SET CO-ORDINATES FOR NEW POSITION
290  X1=-1:Y1=-1:GOTO 370
300  X1=1:Y1=-1:GOTO 370
310  X1=-1:Y1=1:GOTO 370
320  X1=-1:Y1=0:GOTO 370
330  X1=0:Y1=-1:GOTO 370
340  X1=1:Y1=1:GOTO 370
350  X1=1:Y1=0:GOTO 370
360  X1=0:Y1=1
369  REM ** MOVE (OPTIONALLY WITH DRAW/ERASE)
370  IF D0=1 THEN D0=0:POKE P1,C1
380  IF D=1 THEN SET(X,Y):GOTO 430
390  IF D=-1 THEN RESET(X,Y):GOTO 430
399  REM ** STORE CHARACTER AT PRESENT POSITION
400  D0=1
410  P1=1993+INT((X+X1)/2+1)+64*INT((Y+Y1)/3+1)
420  C1=PEEK(P1)
430  X=X+X1:Y=Y+Y1
439  REM ** CHECK FOR OFF SCREEN
440  IF X>95 THEN X=95
450  IF Y>44 THEN Y=44
460  IF X<0 THEN X=0
470  IF Y<0 THEN Y=0
480  RETURN
489  REM ** STORE PICTURE
490  F=0
500  FOR F1=2058 TO 2954 STEP 64
510  FOR F2=0 TO 47:PIC(F)=PEEK(F1+F2)
520  F=F+1:NEXT F2:NEXT F1
530  CLS:PRINT "START CASSETTE IN RECORD MODE"
540  PRINT "PRESS <ENTER> WHEN READY";
550  INPUT A$:CSAVE* PIC
560  PRINT:PRINT "OK PICTURE HAS BEEN SAVED"
570  FOR F1=1 TO 5000:NEXT F1
580  CLS:N=0:FOR X=2058 TO 2954 STEP 64
590  FOR Y=0 TO 47:POKE X+Y,PIC(N):N=N+1
600  NEXT X,Y:X=45:Y=18:D=0:RETURN
610  END
619  REM ** MACHINE CODE DATA
620  DATA 289,1548,13833,8960,-1264,25311,312
630  DATA 18351,10927,-8179,233
640  DATA 31711,12286,288,-2103,5827,13
649  REM ** ASCII CODES FOR COMMAND LETTERS
650  DATA 17,18,19,20,81,82,83,84
660  DATA 68,77,69,67,23,72,66,76,80,47
```

Listing 2. The picture draw and save routine.

In The Mode

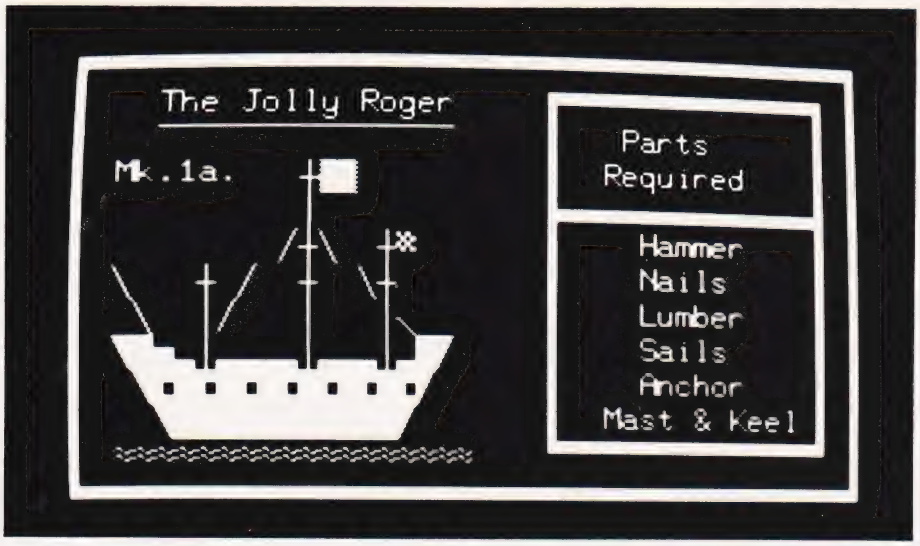
What happens on the screen when the cursor is moved depends upon the mode of operation selected. There are three 'line' modes and one 'character' mode. The three 'line' modes are DRAW, MOVE and ERASE; these can be set at any time by entering the D, M and E commands. DRAW will cause a line to be drawn as the cursor is moved about the screen, ERASE will cause any lines or characters the cursor passes through to be rubbed out and MOVE will allow the cursor to be moved without drawing or erasing. The program is initialised in the MOVE mode.

The 'character' mode is set by entering the C command. This causes a departure from the normal drawing operation of the program to a machine code subroutine allowing the user to enter any alphanumeric or graphic character from the keyboard, including the NAS-SYS editing features. Operation will continue in this mode until a slash, / (ASCII code 47), is entered returning it to the MOVE mode. (NB this character can be obtained for use in a picture by using ASCII code 88 Hex / 136 decimal which is GRAPH/CTRL/H).

Pressing the carriage return key (or 'cursor home') will move the cursor to the beginning of the current drawing line and the H command will move it to the top left corner of the screen. The B command will

```
999  REM ** LOAD AND DISPLAY
     SAVED PICTURE
1000 DIM PIC(720):CLOAD* PIC
1010 FOR X=2058 TO 2954 STEP 64
1020 FOR Y=0 TO 47
1030 POKE X+Y,PIC(N)
1040 N=N+1:NEXT Y:NEXT X
```

Listing 3. The picture recall routine.



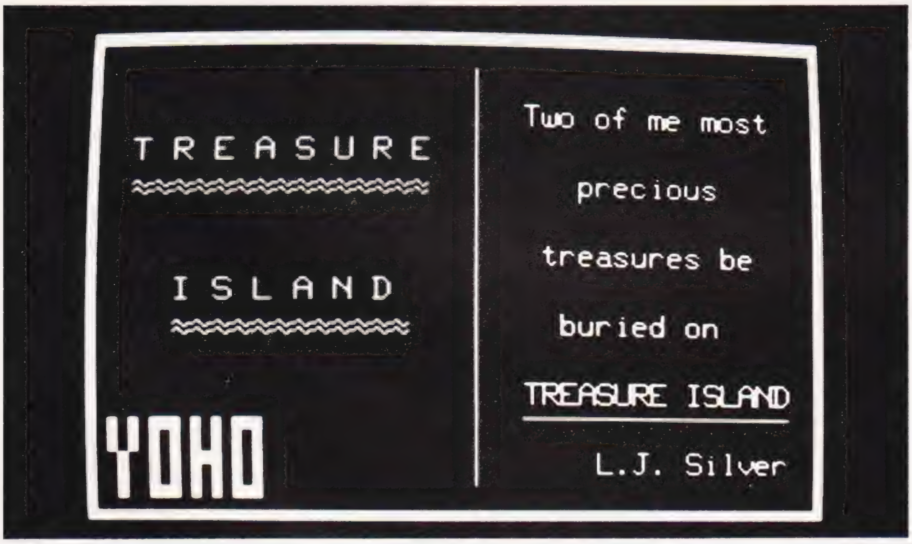
Mixing text and graphics.

blank the screen and reposition the cursor at the centre, the L command then blanking the line (to the height of one character) on which the cursor is currently situated. By moving the cursor to the bottom of the screen and typing L it is possible to scroll the whole picture upwards. When not in the character mode, typing a slash will terminate execution of the program.

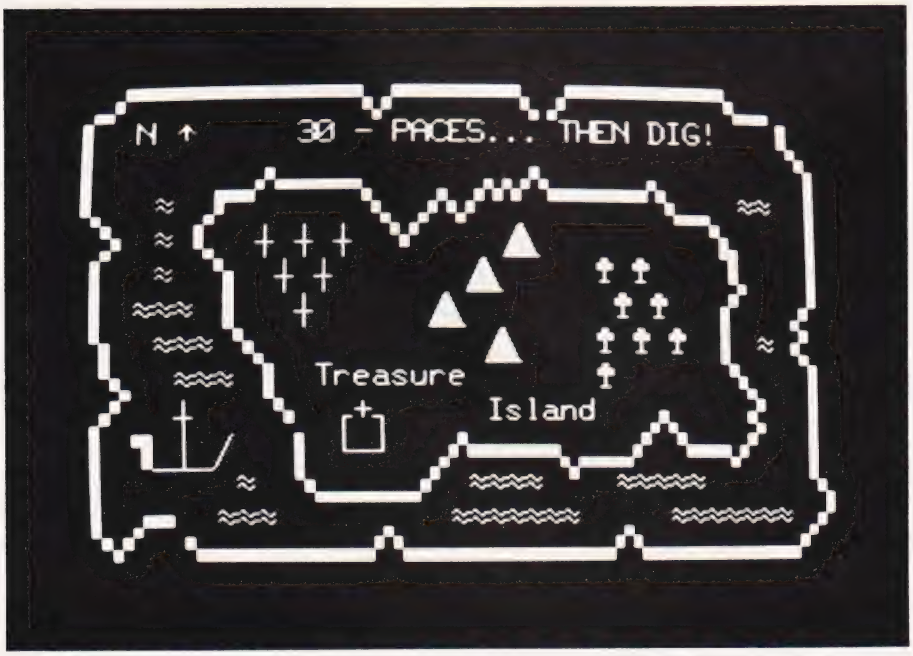
The P command is included to facilitate the storing of pictures on tape. This is achieved by storing each byte of the screen memory as an element of the PIC array and using the BASIC CSAVE* command to save the whole array on tape. Messages appear on the screen to show the start and finish of this operation and on completion, the picture is displayed again and the program returns to the MOVE mode.

To READ in a picture from tape the BASIC CLOAD* command must be used in a routine such as that in Listing 3.

The program contains two machine code subroutines A and B (Listing 1). Subroutine A is called at line 70 and scans the keyboard to see if any key has been pressed (ie any command entered); subroutine B is called at line 250 and controls the operation of the character mode.



A couple of pictures from an adventure game; illustrations for each section of the game can be stored on tape.



How It Works

The following breakdown provides a guide to understanding how the program works and will be useful if you are trying to adapt it for use with other monitors or micros. The REM statements show the various sections quite clearly but may be omitted without any dire consequences.

Line 10: The PIC array will contain all the individual parts of a picture when saved on tape. The AS array contains the ASCII codes of all the legal commands (obtained from the DATA statements in lines 630-640).
Line 20: The data for the machine code subroutines are read and DOKEd into memory from 0D00 Hex onwards.
Line 60: The CDP is set to the centre of the screen and blinked there until a command is entered.
Line 110: The AS array is searched to try to find a match for the ASCII code of the command that has just been entered. If no match is found the command must have been 'illegal' and another one is awaited.
Line 180: If the command was D, E or M then the variable D is set to 1, − 1 or 0 respectively.
Line 210: If the command is 'carriage return', H or L then the CDP is modified accordingly. For L, an ESCape character is also printed.
Line 240: If the command was C then CHARACTER mode is set by calling the machine code subroutine at 0D16 Hex. Control stays within this subroutine until a slash is entered.
Line 290: If the command was a cursor movement command the CDP is modified accordingly.
Line 370: The CDP is either SET, RESET or stored for later recall depending on whether the DRAW, ERASE or MOVE mode was in operation.
Line 440: The CDP is maintained if a cursor movement is entered attempting to place the cursor outside the screen limits.
Line 490: If the command was P then each byte of the screen memory is stored as an element of the PIC array. Instructions are then given to switch on the tape recorder and when the array has been saved, a message to this effect is printed. Finally the picture is returned to the screen, the CDP is centralised and the program continues in MOVE mode.
Line 590: If the command was a slash and the CHARACTER mode is not in operation, then execution of the program is terminated.

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METEORS – your starship is cruising through space when you meet a meteor storm. How long can you dodge the deadly danger?

LIFE – J. H. Conway's 'Game of Life' has achieved tremendous popularity in the computing world. Study the life, death and evolution patterns of cells.

WOLFPACK – your naval destroyer is on a submarine hunt. The depth charges are armed, but must be fired with precision.

GOLF – what's your handicap? It's a tricky course but you control the strength of your shots.

Cassette 2 – Junior

For ZX81 with 16K RAM pack

CRASH – simple addition – with the added attraction of a car crash if you get it wrong.

MULTIPLY – long multiplication with five levels of difficulty. If the answer's wrong – the solution is explained.

TRAIN – multiplication tests against the computer. The winner's train reaches the station first.

FRACTIONS – fractions explained at three levels of difficulty. A ten-question test completes the program.

ADDSUB – addition and subtraction with three levels of difficulty. Again, wrong answers are followed by an explanation.

DIVISION – with five levels of difficulty. Mistakes are explained graphically, and a running score is displayed.

SPELLING – up to 500 words over five levels of difficulty. You can even change the words yourself.

Cassette 3 – Business and Household

For ZX81 (and ZX80 with 8K BASIC ROM) with 16K RAM pack

TELEPHONE – set up your own computerised telephone directory and address book. Changes, additions and deletions of up to 50 entries are easy.

NOTE PAD – a powerful, easy-to-run system for storing and retrieving everyday information. Use it as a diary, a catalogue, a reminder system, or a directory.

BANK ACCOUNT – a sophisticated financial recording system with comprehensive documentation. Use it at home to keep track of 'where the money goes,' and at work for expenses, departmental budgets, etc.

Cassette 4 – Games

For ZX81 (and ZX80 with 8K BASIC ROM) and 16K RAM pack

LUNAR LANDING – bring the lunar module down from orbit to a soft landing. You control attitude and orbital direction – but watch the fuel gauge! The screen displays your flight status – digitally and graphically.

TWENTYONE – a dice version of Blackjack.

COMBAT – you're on a suicide space mission. You have only 12 missiles but the aliens have unlimited strength. Can you take 12 of them with you?

SUBSTRIKE – on patrol, your frigate detects a pack of 10 enemy subs. Can you depth-charge them before they torpedo you?

CODEBREAKER – the computer thinks of a 4-digit number which you have to guess in up to 10 tries. The logical approach is best!

MAYDAY – in answer to a distress call, you've narrowed down the search area to 343 cubic kilometers of deep space. Can you find the astronaut before his life-support system fails in 10 hours time?

Cassette 5 – Junior Education: 9-11-year-olds

For ZX81 (and ZX80 with 8K BASIC ROM)

MATHS – tests arithmetic with three levels of difficulty, and gives your score out of 10.

BALANCE – tests understanding of levers/fulcrum theory with a series of graphic examples.

VOLUMES – 'yes' or 'no' answers from the computer to a series of cube volume calculations.

AVERAGES – what's the average height of your class? The average shoe size of your family? The average pocket money of your friends? The computer plots a bar chart, and distinguishes MEAN from MEDIAN.

BASES – convert from decimal (base 10) to other bases of your choice in the range 2 to 9.

TEMP – Volumes, temperatures – and their combinations.

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SOF06

Henry Budgett

Once more in to the troubled waters of program conversion, the book question and, the BBC Micro.

Welcome, once again, to the warm and friendly atmosphere of the 'micro clinic' — this magazine's answer to All Creatures . . .! My apologies for its absence in the last issue, I trust no-one pined away as a result but The Valley absorbed almost all our efforts. Well, that's my excuse and I'm sticking to it!

The varied mail bag has once again produced a crop of enquiries on topics ranging from the BBC Computer to the apparent inability of certain people to actually read the words we so carefully write on the page.

The Book Question

Ever since we started reviewing books on a regular basis we have been inundated with readers asking about other sources of reference. Among those landing on the office mat in the last few weeks was one from Mr Frater of the North East Wales Institute of Higher Education.

I am currently investigating connecting our SWTP 6800 and PET 8032 computers to control external devices. As my knowledge in this field of computing is limited I wondered if there were any good books in this area.

The answer is a simple 'Yes'. The problem is that there are so many good books to choose from! However, I'd pick the following three, not because they specifically relate to the computers you mention but because they are excellent text-books on the subject from which you should be able to glean all the information you need. They are in no particular order of preference:

Practical Hardware Details for 8080, 8085, Z80 and 6800 Microprocessor Systems by James W Coffron and published by Prentice Hall. The ISBN is 0-13-691089-0 and I'm afraid I've lost the price.

Microcomputer Interfacing by G Jack Lipovski and published by Lexington Books. The ISBN is 0-669-03619-6 and, once again, the price is missing.

Computers and Instrumentation by A Carrick and published by Heyden. The ISBN is 0-85501-452-0 and yes, you've guessed it, the price has fallen out!

On reflection I seem to remember that all were around the £15 mark in hardback but it would be wise to check first.

Still on the subject of books, Mr Law from somewhere unspecified (resisting all those possible puns about addresses was a severe effort) asks:

I hope you can introduce me to a book about programming the 6502.

Here opinions differ. I would personally recommend Leventhal's book, **6502 Assembly Language Programming** which is published by Osborne (McGraw Hill in the UK). However, my colleagues who do the book reviews each month would recommend **Programming the 6502** by Rodnay Zaks. This is published by Sybex and is available in the UK from The Computer Bookshop in Birmingham. The prices were £12.10 and £10.25 respectively at the last check.

Let There Be Light

The subject of light pens for use with personal computers is one that rears its head from time to time and the following inquiry from Mr J R Davies of Lancaster is a typical example.

I want to use my BBC Microcomputer in an application where a light pen may be the most appropriate input device. Can you tell me the names and addresses of any suppliers and whether any special programming is needed.

Apart from the simple light pen design that we published some months ago (you'll have to write your own programs for it) and the one that the BBC should be introducing for the computer, the only one I am aware of comes from Arfon Microelectronics of Cibyn Industrial Estate, Caernarfon, Gwynedd. Now, whether they have yet made a BBC compatible version I'm not sure, but the original version was fairly general purpose and costs around £80 plus the ever present VAT.

As for programming the device, it is impossible to say exactly what will be needed without knowing a great deal more about the actual application. In general I would expect the light pen to come with a control program which could be incorporated into your own software as a special subroutine.

Barrowing Away

Back in our January issue we published a logical adventure game called The White Barrows. Because it was written for the Acorn ATOM which uses a somewhat odd version of BASIC we were fairly careful to point out all the possible points that might need conversion for other types of computer. Now, we know that the game works and that people have managed to convert it — one dedicated individual even has a version running on the Casio FX702 Pocket Computer!

There was, however, one special symbol which we missed, and this occurs at the very beginning of the program. The symbol is @ and can be totally ignored for all other versions of BASIC as its sole purpose in life is to determine the number of spaces available for each number to be displayed in. I trust that answers Mr Foster's enquiry.

The point of this little piece is that two other readers have written in with virtually identical inquiries on the program. Apart from the single point about the @ symbol they go on at extreme length about various other symbols used which they don't appear to understand. The trouble is that they are, without exception, listed and detailed in the text! In fact, we were so worried about the problems this program might cause that we even put a REM in the first line which says PLEASE READ THE TEXT FIRST !!!!!

The moral is, I hope, clear. Before you put pen to paper to write in and enquire about a particular aspect of a program we publish — bugs excepted of course — please read the text and see if it holds the answer. If nothing else it'll save you a stamp!

Given that you can't solve the problem, write to use, **don't phone,** and enclose an SAE at least 9½" by 6½" (A5) and we'll do our best to solve your troubles. The more information you give about the problem the more likely it is that we'll have an answer; statements such as 'It just stopped at line 50' are not much help. A more accurate description of the problem might be 'The screen cleared, there was a pause and then the program stopped with the error message DIV'N BY ZERO IN LINE 50'. Given that sort of detail we can (hopefully) solve the bug.

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SIMULATING FORTH

If you like the look of FORTH as a programming language but are not yet convinced it is the right one for you, why not try out our simulator? Written in BASIC, it will allow you to produce simple programs with ease.

Having been impressed by D S Peckett's series on GOING FORTH in recent issues of Computing Today, I felt that this language had a lot to offer; indeed I wondered if it might be more suitable than BASIC for many of my current projects. I resolved to investigate the language further.

However, the prices of even the simplest versions available in the UK or from the USA are not cheap. Undoubtedly the prices are fair and reasonable but, before spending such an amount, I wanted to be certain that FORTH would suit my requirement fully. More significantly, I wondered if *I* would suit FORTH's requirements. Two points left me in doubt:

1) Would I be able to work easily in Reverse Polish Notation?

2) Would I find it easy to handle the stack?

Both these features are unfamiliar to users of BASIC.

FORTH, Right!

I tried writing a few lines of FORTH and then doing a dry run on paper. I found I was continually scribbling long columns of figures to show what the stack should hold at each stage, often forgetting to delete items already absorbed in a computation or printed out of the stack. The obvious solution to all this tedium was a program in BASIC to do what FORTH would do — the result is this FORTH simulator program.

Make no mistake though, this is by no means a substitute for a true FORTH. It runs only one line at a time and it is ***terribly*** slow. The latter feature distinguishes it at once from FORTH, which is fantastically fast (one of the main reasons that I want to use it). Also, it does not do as much as FORTH.

Despite the above reservations, many readers may find this BASIC version a useful way of 'tasting and testing' the concepts of RPN and the use of a stack-oriented language. Like FORTH, it has a dictionary and you can define new words. Also like FORTH, it is threaded, in that you can define a new word using words you have already defined. One special feature of the simulator is that it displays the stack at each stage of the operation of the program line. It does all that 'scribbling on paper' and does not make mistakes. Here, the slow running of the BASIC version is an asset, since it goes at just the right speed to let you follow what is happening as each stage is executed.

Specification

Dictionary: Holds up to 20 words, each of which can have up to 10 terms to define it. If you want more words or longer definitions, you can easily alter the DIMAW statement in line 20. If you re-define a word, the program uses only the most recent definition and ignores earlier ones. One problem with the TRS-80 is that the colon acts as a delimiter in INPUT lines, so we can not use this to introduce the 'colon definition' as in FORTH. The hash sign is used instead. Thus we can define SQUARE by the line:

```
# SQUARE DUP *
```

The terminal semicolon is not required. Apart from this, the simulator uses exactly the same operators and commands as FORTH.

Stack: Holds up to 10 values and displays all 10 in a vertical column on the screen. The screen holds up to seven print-outs of the stack. These are printed with the tops of stack level; I prefer to think of a stack in this way, with new items pushing the others down and the stack rising when top of stack (TOS) is popped. If a line requires more than seven printings of stack, execution is halted to give you a chance to look at the display. You can then instruct it to continue; printing of stacks begins again from the left of the screen replacing the lists already there. The length of stack can be increased by altering the DIMS statement in line 10. Note that the simulator has only one stack.

To keep the program short and simple there are few error-trapping routines so it is important not to make mistakes when entering lines. However, there is a 'STACK EMPTY!' message.

Arithmetic operators: The program works with positive and

negative integers and has the complete set of operators: +, -, / and *.

Stack operators: DUP, SWAP, OVER, ROT and DROP.

Constants: You can define up to 21 of these (more if you alter DIMAC). Do not put constant definitions in a line with other instructions. The format is the standard one:

<value> CONSTANT <name> . . . then press 'ENTER'

Variables: You can define up to 21 variables (array AV) by the format:

<value> VARIABLE <name> . . . then press 'ENTER'

When the variable is used in a program, its address is put on top of stack followed by the letter 'V' to remind you that this is an address. The addresses are not addresses in RAM, but in the array AV, running from 0 to 20. The operator '!' (store) is usable in connection with variables.

Conditional operators: < > and =.

Conditional loops: There is one format:

<condition> IF <action 1> ELSE <action 2> THEN <continue>

The ELSE is ***not*** optional as in FORTH. If you have no 'action 2' you will need to put a dummy action in its place (eg DUP DROP). Nested loops are not provided for.

Finite loop: There is one format: <upper limit> <start point> DO <action> LOOP <continue>
When in a loop, you can obtain the value of the index by using 'I'. Nested loops are not provided for.

The above is a small subset of FORTH, but should be enough for you to try your hand at the language before deciding to go ahead and buy the real thing. Even when you have FORTH, the fact that this program displays the stack is a real help when you first begin to write your own programs.

Using The Simulator

On keying RUN, the screen is cleared and the displayed message invites you to enter a line of FORTH. Leave **one** space between all terms of the line and take care not to mistype (do not type a space after the last term). Double-check the line, then press 'ENTER'. There will be an appreciable delay while the program runs through the string you have just entered (lines 110-180) and sorts it into individual terms which are put into array A (room for 40 terms, but you could easily extend this).

Next the program will ask for 'Command'. If you want to discard the line just entered, clear the stack and start again, type 'Q' (quit). If you want to step through the line and have the stack displayed at each step, type 'S' for 'step'. Otherwise, type any other letter and the line will be excecuted as a whole, displaying the stack only at the end.

if there are more than seven steps and the screen is full, execution waits until you press any key.

When the print command (.) is used, the FORTH print-out appears on the bottom line of the screen. Subsequent print-outs will appear on the same line, to the right. This is not the same format as in FORTH, but has the advantage that at the end of execution you can see your original line, the states of the stack, the FORTH responses ('OK', etc.) and print-outs, all on the screen at once.

When execution is complete, the program waits (line 330) for a keypress. If you press 'R' the program is re-run and you lose all defined words, constants, variables and the stack. If you press 'C', however, you retain everything but the stack, which is cleared. If you press any other key, you simply return to enter a new line with everything intact. This allows you to go on from line to line when trying a more extensive program.

VARIABLES

A$	Array of terms of FORTH program line.
AA$	A character taken from A$.
AC$	Array of CONSTANTS.
AS$	Term to be put on top of the stack.
AV$	Array of VARIABLES.
AW$	Array of words (DICTIONARY).
B$	Input commands.
C	Number of stack displays on screen.
D	Number of responses printed at bottom of screen.
DF	'DO . . . LOOP' index at finish.
DJ	Value of J for 'DO'.
DS	'DO . . . LOOP' index at start.
FF	Flag for function found; = 0 if not found, = 1 when found. Used in execution to indicate than an operation has been identified and executed.
FS	Flag for single-step; = 1 for single-step.
FT	Flag in 'IF . . ELSE . . THEN' loop; = 0 if condition is false, = 1 if true (ie FT = TOS)
FW	Flag for word found; = 1 when search of dictionary has found a word.
J	The number of the term currently being executed.
J1	Temporary register for J in 'IF . . . ELSE . . . THEN' loops.
K	Loop counter.
LA	Number of characters in input string A$.
N	Array of number of terms in each word in AW$.
NC	Number of most recently defined constant defined in AC$ (0 to 20).
NV	As above, for variables in AV$.
NW	As above, for words, except that words are listed from location 20 downwards(20 to 0).
S$	Stack; S$(0) is TOS.
T	Number of terms in a line.
VA	ASCII value of AA$.

Program Listing

```
10  REM ** FORTH SIMULATOR IN BASIC
20  CLEAR 2500:DEFSTR A,B,S:DEFINT C-R,T-Z:
    DIM A(40):DIM AC(20,1):DIM AV(20,1):DIM AW(20,10):
    NW=20:DIM N(10)
30  REM ** CLEAR THE STACK
40  FOR J=0 TO 9
50  S(J)=" ."
60  NEXT J
70  CLS:PRINT "ENTER LINE OF FORTH PROGRAM"
80  FOR J=0 TO 30:A(J)="":NEXT J:T=0:C=0:D=0
90  INPUT A$
100 REM ** SEPARATE TERMS INTO LIST
110 LA=LEN(A$)
120 FOR L=1 TO LA
130 AA=MID$(A,L,1)
140 VA=ASC(MID$(A,L,1))
150 IF VA>47 AND VA<58 OR VA>64 AND VA<91 THEN
    A(T)=A(T)+AA
160 IF VA=32 THEN T=T+1
170 IF VA>41 AND VA<48 OR VA=33 OR VA=35 OR VA>59 AND
    VA<63 THEN A(T)=AA
180 NEXT L
190 REM ** READY TO PROCESS THE LINE
200 B=""
210 INPUT "COMMAND";B
220 IF B="Q" THEN 40
230 IF B="S" THEN FS=1
240 REM ** PROCESSING NEW WORDS, CONSTANTS AND
    VARIABLES
250 IF A(0)="#" THEN N(NW)=T-1:FOR K=1 TO T:
    AW(NW,K)=A(K):NEXT K:NW=NW-1:GOTO 70
260 IF A(1)="CONSTANT" THEN AC(NC,0)=A(2):
    AC(NC,1)="[SPC]"+A(0):NC=NC+1:GOTO 70
270 IF A(1)="VARIABLE" THEN AV(NV,0)=A(2):
    AV(NV,1)="[SPC]"+A(0):NV=NV+1:GOTO 70
280 J=0
290 GOSUB 1000
300 IF T>J THEN J=J+1:GOTO 290
310 IF FF=1 OR FW=1 THEN PRINT@960+D*8,"OK";:D=D+1
320 B=INKEY$:IF B="" THEN 320:REM ** WAITING AFTER
    PROCESSING AN INPUT
330 IF B="R" THEN RUN
340 IF B="C" THEN 30
350 GOTO 70
1000 FF=0:FW=0:REM ** EXECUTING NORMAL LINES
1010 IF A(J)="IF" THEN FT=VAL(S(0)):J=J+1:AS=S(1):
     GOSUB 4000:IF FT=0 THEN GOSUB 2000
1020 IF A(J)="ELSE" AND FT=1 THEN J=J+1:GOSUB 2500
1030 IF A(J)="THEN" THEN J=J+1
1040 IF A(J)="DO" THEN DS=VAL(S(0)):DF=VAL(S(1)):
     AS=S(1):GOSUB 4000:AS=S(1):GOSUB 4000:DJ=J:RETURN
1050 IF A(J)="LOOP" AND DS<DF-1 THEN J=DJ:DS=DS+1:FF=1:
     RETURN
1060 IF A(J)="LOOP" AND DS=DF-1 THEN FF=1
1070 IF A(J)="I" THEN AS=STR$(DS):GOSUB 4000
1080 IF ASC(LEFT$(A(J),1))>47 AND ASC(LEFT$(A(J),1))<58
     THEN AS="[SPC]"+A(J):GOSUB 3000
1090 IF ASC(LEFT$(A(J),1))=45 AND LEN(A(J))>1 THEN
     AS=A(J):GOSUB 3000
1100 GOSUB 7000
1110 GOSUB 8000
1120 GOSUB 9000
1130 IF FW=1 THEN RETURN
1140 IF S(0)=" ." AND FF=0 THEN 6000
```

SIMULATING FORTH

```
1150  IF A(J)="." THEN PRINT@960+D*8,S(Ø);" OK";:D=D+1:
      AS=S(1):GOSUB 4000
1160  IF A(J)="DUP" THEN AS=S(Ø):GOSUB 3000
1170  IF A(J)="DROP" THEN AS=S(1):GOSUB 4000
1180  IF S(1)=" ." AND FF=Ø THEN 6000
1190  IF A(J)="+" THEN AS=STR$(VAL(S(Ø))+VAL(S(1))):
      GOSUB 4000
1200  IF A(J)="-" THEN AS=STR$(VAL(S(Ø))-VAL(S(1))):
      GOSUB 4000
1210  IF A(J)="*" THEN AS=STR$(VAL(S(Ø))*VAL(S(1))):
      GOSUB 4000
1220  IF A(J)="/" THEN AS=STR$(INT(VAL(S(Ø))/VAL(S(1)))):
      GOSUB 4000
1230  IF A(J)="<" THEN AS=" Ø":IF VAL(S(Ø))>VAL(S(1))
      THEN AS=" 1":GOSUB 4000
1240  IF A(J)="<" THEN GOSUB 4000
1250  IF A(J)=">" THEN AS=" Ø":IF VAL(S(Ø))<VAL(S(1))
      THEN AS=" 1":GOSUB 4000
1260  IF A(J)=">" THEN GOSUB 4000
1270  IF A(J)="=" THEN AS=" Ø":IF VAL(S(Ø))=VAL(S(1))
      THEN AS=" 1":GOSUB 4000
1280  IF A(J)="=" THEN GOSUB 4000
1290  IF A(J)="SWAP" THEN S=S(Ø):S(Ø)=S(1):S(1)=S:FF=1
1300  IF A(J)="OVER" THEN AS=S(1):GOSUB 3000
1310  IF A(J)="!" THEN AV(VAL(S(Ø)),1)=S(1):AS=S(1):
      GOSUB 4000:AS=S(1):GOSUB 4000
1320  IF S(2)=" ." AND FF=Ø THEN 6000
1330  IF A(J)="ROT" THEN S=S(2):S(2)=S(1):S(1)=S(Ø):
      S(Ø)=S:FF=1
1340  IF FF=Ø THEN PRINT@960+D*8,A(J);"?";:D=D+1
1350  IF FS=Ø AND J<T THEN RETURN
1360  FOR K=Ø TO 9:REM ** PRINT STACK
1370  PRINT@256+K*64+C*8,"[8 SPC]";
1380  PRINT@256+K*64+C*8,S(K);
1390  NEXT K
1400  C=C+1:IF C>7 THEN C=Ø:GOSUB 5000
1410  RETURN
2000  J1=J+1:REM ** EXECUTING 'IF'
2010  IF A(J1)="ELSE" THEN J=J1+1:RETURN
2020  J1=J1+1:IF J1>T THEN PRINT@960+D*8,"NO IF!";:D=D+1
2030  GOTO 2010
2500  J1=J+1:REM ** EXECUTING 'ELSE'
2510  IF A(J1)="THEN" THEN J=J1+1:RETURN
2520  J1=J1+1:IF J1>T THEN PRINT@960+D*8,"NO ELSE!";:
      D=D+1
2530  GOTO 2510
3000  FOR K=9 TO 1 STEP-1:REM ** NEW TOS AND MOVE STACK
      DOWN
3010  S(K)=S(K-1)
3020  NEXT K
3030  S(Ø)=AS
3040  FF=1
3050  RETURN
4000  S(Ø)=AS:REM ** NEW TOS AND MOVE STACK UP
4010  FOR K=1 TO 8
4020  S(K)=S(K+1)
4030  NEXT K
4040  S(9)=" ."
4050  FF=1
4060  RETURN
5000  IF INKEY$="" THEN 5000:REM ** SCREEN IS FULL SO WAIT
      TO DISPLAY NEXT STACK
5010  RETURN
6000  PRINT@960+D*8,"STACK EMPTY!";:REM ** EMPTY STACK
      ERROR
6010  GOTO 320
7000  FOR K=Ø TO 20:REM ** SEARCHING DICTIONARY
7010  IF A(J)=AW(K,1) THEN T=T+N(K):FW=1:FOR I=T TO
      J+N(K)+1 STEP-1:A(I)=A(I-N(K)):NEXT I:FOR I=1 TO
      N(K):A(J+I)=AW(K,I+1):NEXT I:RETURN
7020  NEXT K
7030  RETURN
8000  AS="AS":REM ** LOOKING FOR A CONSTANT
8010  FOR K=Ø TO NC
8020  IF A(J)=AC(K,Ø) THEN AS=AC(K,1)
8030  NEXT K
8040  IF AS<>"AS" THEN GOSUB 3000
8050  RETURN
9000  AS="AS":REM ** FINDING THE ADDRESS OF A VARIABLE
9010  FOR K=Ø TO NV
9020  IF A(J)=AV(K,Ø) THEN AS=STR$(K)+"V"
9030  NEXT K
9040  IF AS<>"AS" THEN GOSUB 3000
9050  RETURN
```

A P Stephenson

In this, the second part of our series on interfacing, we take a look at the art of economising on I/O lines.

In last month's article all the assumptions were based on the schematic outline of Fig. 1 (see the April issue), which defined a system based on only one input and one output. Many practical systems, however, may require many such inputs controlled by one computer.

Because we are dealing with a number of analogue inputs it is obviously going to be more efficient to select which of these is fed to the A to D converter than to select which of a number of A to D converters we connect to the computer - it's going to be a lot cheaper too! The converse applies to the output side as well, of course.

The devices we are going to look at belong to a family known as multiplexers and although they are digitally controlled, they switch analogue signals. A multiplexer allows a number of inputs — how many depends on the specific device chosen — to be selected in order. The reverse function is performed by a de-multiplexer.

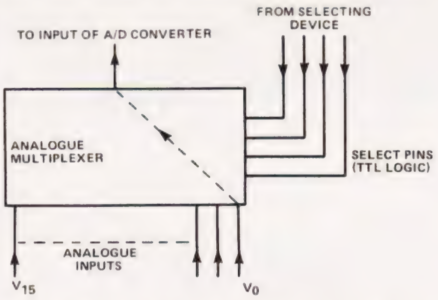


Fig. 4. Typical pin functions of a 16-way analogue multiplexer.

Multiple Connections

The functions of a typical 16-way multiplexer are shown in Fig. 4. Any of the analogue inputs can be selected by setting the appropriate binary code on the four select pins. For example, the code 0011 would select the input V_3. The controller for the multiplexer is often part of the computer, indeed it may even be the computer, or it can be a separate 'black box'.

Figure 5 shows the functional arrangement of a 16-way demultiplexer and this works in exactly the reverse fashion to the multiplexer in that the code selected determines which of the outputs the signal appears on.

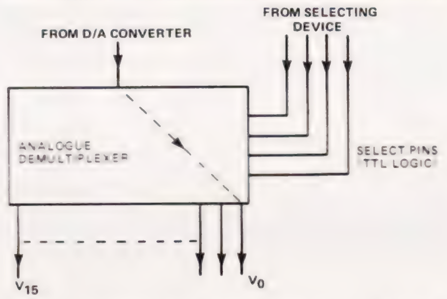


Fig. 5. Typical pin functions of a 16-way analogue de-multiplexer.

Warm Or Golden?

The number of lines available on input/output devices is often limited. Many systems provide the eight data lines and two control lines; often referred to as handshake lines. If you refer to last month's article, the two lines 'sample' and 'valid' shown in Fig. 2 would have been connected as handshake lines.

Although this limitation is often built-in when you buy the system, there is often no reason why the number of I/O lines cannot be expanded, provided of course there are spare addresses in the memory map. Indeed, many of the microcomputer manufacturers offer extra I/O cards for just these purposes.

Once you start to look at the limitations, however, it is often suprising to find how much you can do with the limited facilities provided. Devices such as counters and shift registers often come in very useful and Fig. 6 shows one possible solution. The software needed to operate this could commence with the counter set to zero; resetting on power-up being the logical method. With the counter at zero, input V_0 is selected and appears at the input to the A to D converter. Nothing will now happen until the computer sets the handshake line connected to the sample input of the A to D. When the valid line changes state the computer can read the data and store it at a convenient location in memory. A pulse is now sent to the counter which causes the next input line to be selected. How this pulse is derived depends on the system you have available but it could be achieved by delaying the valid pulse by an amount sufficient to read the data into the computer and then using it to generate the clock for the counter.

This process will now continue until the counter reaches 16 at which point the counter will have to be reset and the process started all over again.

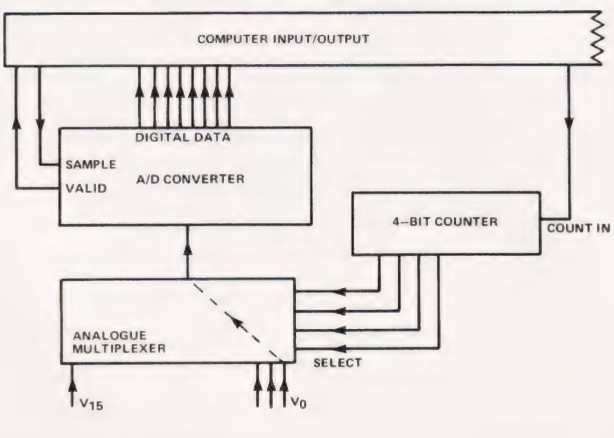


Fig. 6. Handling the multiplexer.

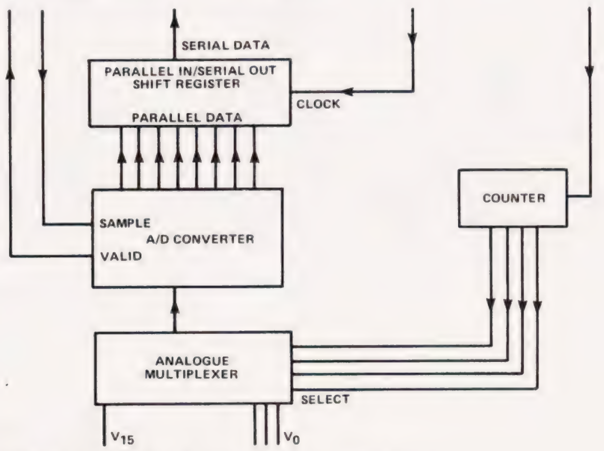


Fig. 7. Using a shift register to serialise data.

Bit By Bit

It is possible to make even less demand on the number of I/O lines by using a shift register to convert the parallel output of the A to D converter to a serial bit-stream which only uses one data line. Figure 7 illustrates this. The cycle of operations is fundamentally the same as that described for the last example except that the shift register is supplied with a clock signal converting the parallel data from the A to D into a serial bit-stream.

The process is, of course, slower than the previous method because each byte delivered by the A to D will require eight clock pulses to feed it into the computer. The saving in the number of I/O lines tied up is substantial though.

It must be emphasised that all these examples are simply schematic representations of the processes involved and cannot be taken as working models. To implement them in hardware will require specific information on the various devices and data sheets and applications notes should be consulted.

Switches And Relays

Many applications of computer control do not involve A to D or D to A conversion techniques. Often, the computer is merely required to sense whether a particular switch is on or off. Similarly, the system may be required to operate switches at various locations and, because the voltages being controlled are greater than those used within the computer, some form of isolation must be used. Various options exist and are in common usage.

Reed Relays: These are very popular and can be obtained in a variety of forms including DIL packaging. Figure 8 shows the construction of a typical device of this type. Their action is similar to a more conventional type of relay but they can generally be made much smaller. The operating coil only requires a small current and may be driven directly from the computer; special TTL compatible types are generally available. It is essential to place a reverse biased diode across the coil otherwise the back emf generated when the coil is turned off may damage the driving IC.

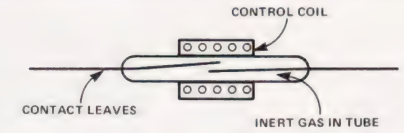


Fig. 8. A sectional view of a reed relay.

Opto Isolators: These act as almost 'perfect' relays and are becoming very popular as isolating components. Figure 9 illustrates the various functions.

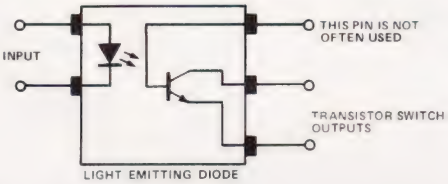


Fig. 9. An opto-isolator.

A small current flowing through the LED causes light to fall on to the base of the phototransistor and this allows current to flow from the collector and emitter. There is complete DC isolation between the two halves of the device and they can be driven directly from TTL levels. Because the transistor is a small device it can only carry a low current so in many cases a second transistor will be used to drive the final load.

A further use for opto isolators is as a terminating device on long lines. Logic devices can often suffer from the effects of RFI picked up by long cable runs acting as aerials; terminating lines of this type with a load can often reduce the effects.

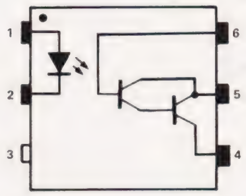
A practical circuit for driving a 24 V DC motor under computer control is given in Fig. 10. The system is using negative logic so the output from the computer must go low to turn the motor on. The reverse biased diode across the motor is present for the same reasons as the one across the relay that was mentioned earlier. We are also using a pair of transistors in this example to boost the current carrying capacity of the photo transistor — we could not simply use the photo transistor as it would be burnt out.

Driving mains voltages is something that should be undertaken with care and opto isolators again prove their worth in this area. Figure 11 shows a practical example which will control a 0.5 kW load. Notice that there is no electrical connection at all between the 5 V logic circuitry and the 240 V AC mains, it's all done by light!

The computer can turn on the mains device by setting the output line high causing the phototransistor to conduct. This turns on the gate of the triac and, in turn, causes the triac to conduct thus turning on the load. The resistor and capacitor across the triac act as a 'snubber' network and prevent false triggering.

Higher powered opto isolators are also available using a Darlington pair transistor configuration (Fig. 12 shows an example) and they are also available in sets of four, Fig. 13.

Fig. 12. A Darlington opto-isolator.



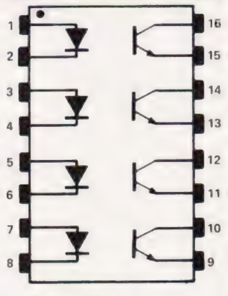


Fig. 13. A quad opto-isolator.

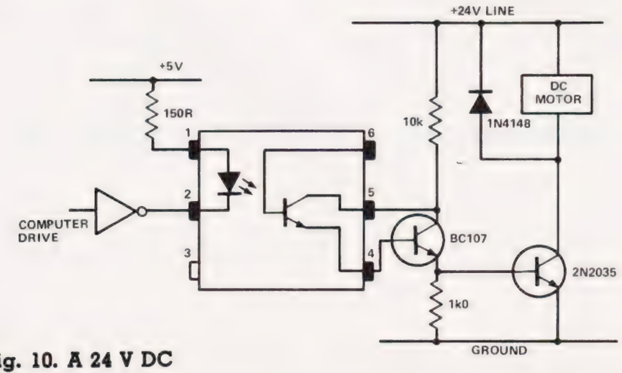


Fig. 10. A 24 V DC motor.

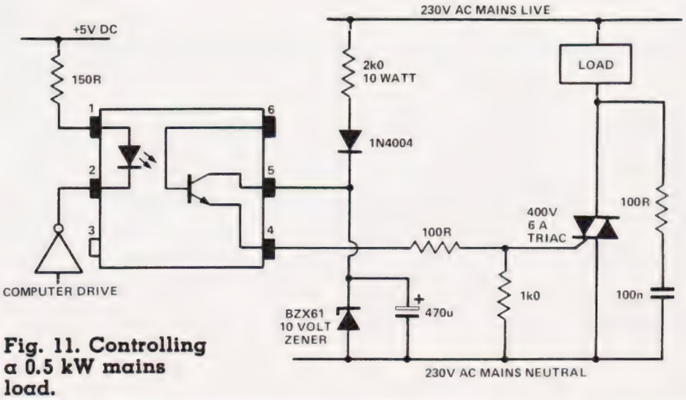


Fig. 11. Controlling a 0.5 kW mains load.

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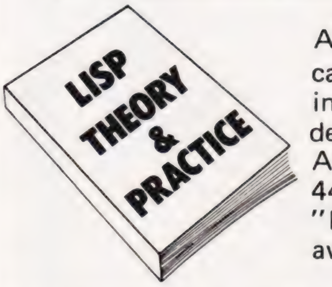

ATOM LISP is available on cassette at only £17.25 inc VAT from your Acorn dealer or direct from Acornsoft. Accompanying 44 page instruction manual "Lisp Theory and Practice" available for £6 (no VAT).

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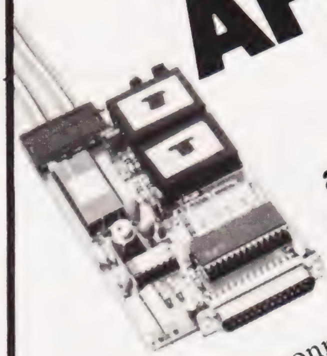

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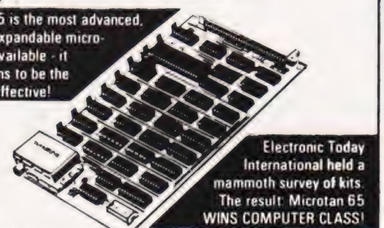

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Dear Sir,

I see from your April edition that the May issue is to include an article on what to expect next from the BBC and the manufacturers of the BBC Micro.

Please do not let anyone repeat the myth that the backlog of orders has been almost overcome. Some of your competitors have let it be known that the back order positions will be up to date by the end of March.

I recently enquired about my own order and was told that if I ordered in mid-January (which I did) I should receive my microcomputer some time in May. It seems that the problems are far from overcome and, presumably, anyone ordering now can expect to wait until June or July. It would be helpful to your readers if you could publish the true current position.

Your faithfully,
T G R Lawrence
London

(***By now I hope that you have read our feature on the BBC apres-le-series part one. I would hardly describe our comments on the state of play delivery-wise as being over-optimistic!! Ed****)*

Dear Sir,

I think that British computer magazines are better than the ones available here in the US. When I left London to move to Colorado, I bought a subscription to CT because it was a very good, all round magazine (and quite affordable). However, I am sorry to say that the quality of the content and organisation of the magazine has declined in the past few months. The technical articles are now far too technical (some too difficult to follow — some just plain useless), and the beginner's articles seem to be aimed at the simpleton. 1980 and 1981 were your best years ever.

Of course, this is just my opinion, many people must be delighted with the new format. #File is an excellent added feature which will probably grow into your best 'regular feature'.

Yours sincerely,
Darius Ragheb
Colorado, USA

PS Don't get too hung up about the BBC machine.

*(****I trust that your distance from the UK market, for which our magazine is primarily intended, and your close proximity to the US market, which is, to say the least, somewhat differently oriented has not clouded your judgement. Nevertheless, your opinion is valued and anyone else with a similar view should write and let us know. After all, what point is there in us slaving away to produce this magazine if we aren't filling it with what you want to read? Ed****)*

Dear Sir,

*Beginners who have struggled through their provisional copies of the User's Guide for the Proton (****I think he means BBC Micro. Ed****) may be a little mystified about the colours in Teletext mode (MODE 7). A 'phone call to Acorn provided the information that a control code in the region of 82 Hex (130 decimal) was required.*

A little experimentation produced the following results: if a string is preceded by a CHR$(X) statement, it will be printed in colour (if the colour is followed by CHR$(&88), the output will be a flashing colour) when X has the values give below.

Hex	Dec	Colour
81	129	Red
82	130	Green
83	131	Yellow
84	132	Blue
85	133	Magenta
86	134	Cyan
87	135	White
88	136	(Flashing)

Large characters can be generated using CHR$(141). However, since these letters need two lines, the commands must be given twice:

```
10 PRINT CHR$(141) ''DOUBLE SIZE''
   CHR$(141) ''DOUBLE SIZE''
```

The first occurrence of CHR$(141) prints the top halves of the letters, the second occurrence prints the bottom halves. In fact, the two strings need not be the same, which can produce some interesting effects!

These can be 'stringed' together:

```
20 PRINT CHR$(130) CHR$(136)
   CHR$(141) ''TELETEXT'' CHR$(130)
   CHR$(136) CHR$(141) ''TELETEXT''
```

This will produce the word 'TELETEXT' in large green flashing letters. Changing the codes will make the two halves different colours.

Yours faithfully,
Carl Zetie
Maidenhead

Dear Sir,

Firstly, I must congratulate you on the consistent good quality of your magazine, providing useful information and well-debugged programs (unlike 'certain' others). Even the fearsomely unreadable 'Buyers' Guides' are well worth the space, if only for their quantity of useful information.

In return for the above sample of unadulterated pluggery, I would be obliged if you would publish the information below (as well as the testimonial above).

Having read your series of articles on the language 'FORTH', I was moved to begin writing a line-by-line 'tiny' compiler with pseudo-string handling capability. However, after trying out some of my later versions, I have discovered that FORTH is far too structured for me (my programs are usually unstructured enough to curdle milk at fifty paces) and decided not to continue with it. However, rather than waste my hours of toil, I would be only too glad to tape for anyone with a Microtan 65 with more than 2K (or a micro that will load Tangerine-dumped programs) the 2½K of not-entirely-debugged code I have written. If you would like this program, please send me a cassette and an SAE to 63 London Road, Maidstone, Kent.

If anyone is in a similar situation with a Tiny BASIC interpreter, I would be most interested in a swap.

Yours faithfully,
J M Styles
Maidstone

Dear Sir,

I am writing to ask you to update your User Group Index.

The North West TRS-80 Users Group has monthly meetings, a bi-monthly newsletter, a members software library, Sub groups and more. Will exchange newsletters with any other TRS-80 users group. For more details contact:- Melvyn D Franklin, 40 Cowlees, Westhoughton, Bolton BL5 3EG. Tel:- Westhoughton (0942) 812843.

Yours faithfully,
Melvyn D F Franklin
Group Secretary

Dear Sir,

I would be very pleased if you could update the entry for the Amateur Computer Club's 2650 Library to that given below and indicate to your readership that the library is now alive and kicking once more after a short period of hibernation caused by my recent move.

Wishing you and the magazine all the best.

Yours faithfully,
Roger A Munt
Tyn-y-Coed
Kilnwood Lane
South Chailey
East Sussex BN8 6AU

Dear Sir,

We would be most obliged if you will let your readers in the Hartlepool area know that a Computer Club has been started.

The first meeting of the Club was held at the Welfare Hall For The Blind, Avenue Road, Hartlepool on Friday, 26th February, 1982.

Mr Harry Cuthbert, the Acting Chairman, and Mr David Jones, the Acting Sec., can both be contacted after 6.30pm most evenings on Hartlepool 71027 or 66001.

It is hoped that anyone who has an interest in computing will join the Club, 'non owners' are also most welcome.

Yours faithfully,
David R V Jones
Cleveland

Dear Sir,

A few month's ago I wrote to you for help with your 'Morse code' program, and 'Pools predict' program.

I wish to say thank you for your prompt and speedy reply, together with your Programming Standards enclosure.

These are both now running properly, and I can assure you that I look forward to the future copies of Computing Today.

Thanking you again, a very satisfied customer.

Yours faithfully,
I Coulson
Invergowrie

(***I think the fact that you remembered to enclose an SAE of sufficient size may well have had something to do with it! Ed***)

Dear Sir,

The superb program in your February issue for Auto Numbering on NASCOMs does, indeed, require a small change to work with NAS-SYS 3. Unfortunately, just changing the length of the table does not work as LNVAL overwrites the repeat keyboard routine address with disastrous results.

It is necessary to change the address of the registers and 0D20 Hex for LNVAL gives a POKE address of 3360 — quite easy to remember.

The new BLINK routine is now at 0D25 Hex so 0D17 Hex requires changing to 21 25 0D and all register addresses require changing to LNVAL 0D20
INCVAL 0D22
FLAG 0D24

Yours faithfully,
A Marshall
Huddersfield

Dear Sir,

Thank you for your very comprehensive review of the BBC Microcomputer. It arrived about the time I received my computer and has been most useful. It is disappointing to find that the documentation is so incomplete and that it will, it seems, be much less comprehensive than the ATOM manual. However, we must all wait and see, I suppose.

There are a couple of hardware points mentioned in your review that do not apply to my machine: the PSU transformer is not toroidal, but is a very ordinary open frame type whose substantial stray magnetic field causes a lot of mechanical hum from the steel PSU case and is bad news for a TV tube. And, all the support and memory chips are soldered direct to the board, ie not socketed.

There is another point worth noting, and that is that the BNC connector does not provide a colour signal as specifically stated in both the BBC hardware specification and in their brochure published last summer. This is evident from the circuit on page 221 of the manual which shows that raw RGB/Sync signals are summed by transistor Q7; this has been confirmed today by a letter I have had from Acorn's Technical Department. It means that colour monitors requiring a PAL-encoded composite video signal, such as the TV sets with a video tape recorder input that are now coming on the market, will provide only a B/W picture. Acorn also confirm, incidentally, that the firmware in EPROMs will be replaced eventually by ROM 'as soon as possible' but can give no idea when.

Finally, I have had the power supply cut out on a few occasions after about one or two hours' use. The PSU runs extremely hot (I've roughly measured 62 °C) so that may be the cause as all seems to be well after switching off for five or 10 minutes. I would like to hear whether you or any other user has had a similar problem.

I hope all that does not sound churlish when Acorn and the BBC have given us such a splendid machine — it has taken a little of the gilt off the gingerbread, though!

Yours sincerely,
Brian Carroll
Aldershot

(***To set your mind at rest over a couple of points, you might be interested to hear that the new User Guide is very, very good indeed. By the time it is bound, hopefully in a spiral or ring binder, it will be some 500 pages long and represents an excellent piece of documentation. It will also be supported by a number of specialist interest manuals for the Assembler and a couple of the more esoteric and advanced functions.**

The monitor drive from the BNC is black & white, as expected...however, there is an RGB output which gives a much higher picture quality than a composite signal.

The ROM-based firmware will not be released until the DOS is up and running, see 'Aftermath' in the last issue. Ed*)

Dear Sir,

This letter is to introduce myself as the Public Relations Officer for the East London Amateur Computer Club.

The Club meets at the Harrow Green Library, Cathall Road, Leytonstone, London E11. We meet on the second and fourth Tuesday of each month. The first meeting is a lecture meeting, and we try to obtain people from *outside the Club. The second meeting is usually a talk-in. Some of the members bring their processors, and leave them to be used by members who do not have access to a micro. Various languages are in use by members; we have a FORTH interest group in the Club.*

Because of conditions at our meeting place there may be changes of venue, but not yet. The hall we meet at is underneath the library and this may be moved downstairs to accommodate the elderly and disabled using the library. By having the library downstairs and the meeting hall upstairs, this will inconvenience fewer using the facilities of the building (it may also improve the facilities available by making room in the building for more spare time activity groups to have a meeting place).

Yours faithfully,
J Turner, PRO
East London Amateur
Computer Club

Dear Sir,
I have just read the article on PROLOG in your February 1982 issue. The description of the language was good, given the available space, but there are background points which were omitted and might be of interest to your readers.

To help put the importance of the language into perspective, there are two points to be made. Firstly, that PROLOG (or a PROLOG-like language) is to be used as the basic systems programming language for the proposed Fifth Generation Japanese computers. Secondly, that one of the most important application areas of PROLOG is in writing 'expert systems' — systems which embody specific areas of human expertise and can be used as consultants in those areas. Expert systems is itself a very important growth area in computing.

For those who wish to find out more, an excellent textbook is now published by Springer-Verlag. Called 'Programming in PROLOG', it describes the facilities and workings of the language for programmers and non-programmers alike. The book was written by Bill Clocksin and Chris Mellish who have themselves implemented PROLOG. In cases of difficulty, we can supply the book from stock (£8.75 plus £1.15 p&p).

For anyone who is tempted to buy PROLOG, we also sell the Clocksin & Mellish implementation.

Yours faithfully,
Ann Goodall
Knowledge Engineers & Designers of Expert Systems
34 Alexandra Road
Oxford OX2 0DB

Dear Sir,
I note that in the process of preparing my contribution to Viewpoint, p17 CT April, 1982, someone has altered one of the sentences in it in such a fashion as to totally destroy the meaning intended. I refer to lines seven and eight of the paragraph headed **An Easy Answer?**

The version printed reads, 'Why this has not been done before I really do not know.' The implication being that I think such courses are a good idea. The text submitted read, 'Why I really do not know.' My intention was to convey that such courses are a waste of time and that the organisers have given little real thought to the problem.

I would be obliged if you would take steps to correct the quite wrong impression which the text, as published, gives.

Yours sincerely,
Les May
Rochdale

(***Apologies in profusion but this was a case of trying to turn the sentence in question into readable English and misunderstanding it ourselves rather than a deliberate attempt to alter your intent. As a general note to authors: if you are seeking to make a point to the reader, do try to put it into clear English before you send it to us...! Ed***)

Dear Sir,
Could you please inform your readers that the North Wiltshire Computer Club is now running and is looking for more members. Meetings are held at Holt village hall on the second and fourth Wednesdays of each month (Holt is between Melksham and Bradford-on-Avon). Anyone is welcome, from absolute beginners to 'experts', upon paying a 50p entrance fee. Persons who feel they could give us a demonstration talk are welcome to do so.

If you are interested in coming along then either turn up (7.00-11.00), write to Matthew Jones, Pinhills, Bowood, Calne, Wilts SN11 0LY or Gary Hawkins, 198 The Common, Holt, Trowbridge or 'phone Gary on North Trowbridge 782025.

Yours faithfully,
Matthew Jones
Joint Chairman

Dear Sir,
I refer to the article on PROLOG in the February 1982 issue of Computing Today, Pages 42-44. I found this an interesting article, but should like to point out a discrepency between Figures 1 and 2.

In Figure 1, the family tree, the parents of Bertha are shown as Florence and Walter, and the parents of John as Liza and Dick. In Figure 2, the initialisation of the program, however, the following lines appear.

```
01300 father (John, Walter)
01400 mother (John, Florence)
      ,
      ,
      ,
02100 father (Bertha, Dick)
02200 mother (Bertha, Liza)
```

These lines should have read:

```
01300 father (Bertha, Walter)
01400 mother (Bertha, Florence)
      ,
      ,
      ,
02100 father (John, Dick)
02200 mother (John, Liza)
```

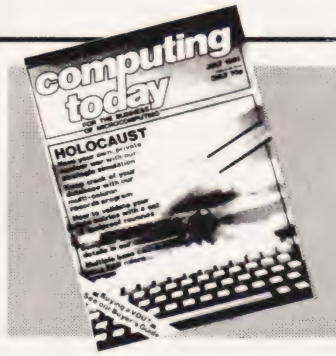
in order to make the two figures agree. I feel that this could have caused some confusion, as it did with some of my colleagues.

Could you please point this out in the next issue.

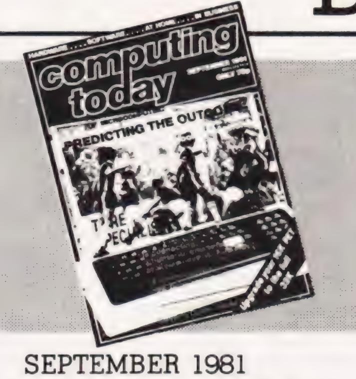
Yours faithfully,
J B Owen
Advanced Avionic Systems Group
British Aerospace
Warton

(***While your observations are absolutely correct I think it only fair to point out that these were meant as examples and not as actual working models! However, point taken and my apologies. Ed.***)

BACKNUMBERS



JULY 1981
Holocaust wargame, Data entry validation routines, Multiple column records program, Media survey.



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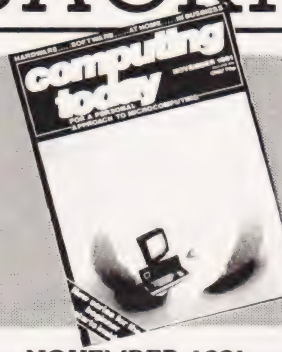

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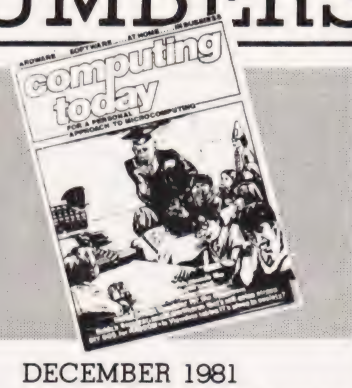

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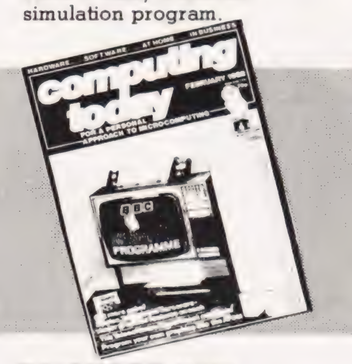

FEBRUARY 1982
The Computer Programme investigated, Graphics for Apple, Sorcerer and Tandy, User programmable graphics for ATOM.

MARCH 1982
User report on BBC Micro, DIY computerised security system, Terminology translated, Classroom computers reviewed.

APRIL 1982
The Valley program, TI 99/4 and Tandy Color Computer reviewed, Report on Centronics 737/739 printers, Interfacing series.

Last month's issue is still available as well but has not yet reached the end of its 'shelflife' and is not included for this reason.

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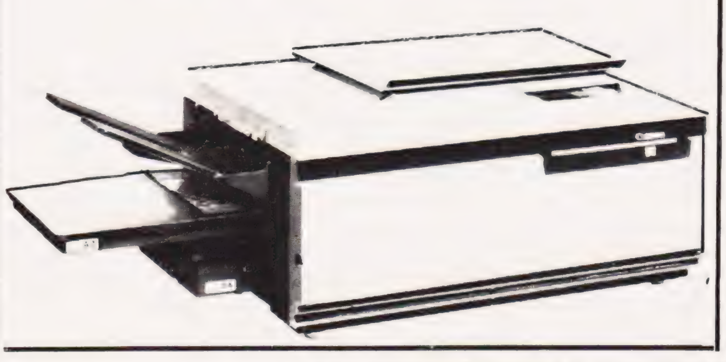

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FIRST BYTES

P Freebrey

Your micro is just as adept at handling text as it is at processing numbers — inside the machine they all look the same! This month our series on elementary BASIC programming takes a look at string functions and their uses.

Sadly, we are nearing the end of this series of First Bytes and I have to select what areas of programming to cover in the last two articles. One topic which can cause some initial difficulty is string handling. What is a string? Other than being a length of thin cord, the term is used in the language of computers to represent a set of characters enclosed between quotation marks. These are assigned to a string variable so:-

```
10 A$ = "JOHN SMITH"
```

String variables are identified in most BASIC languages by having the '$' sign as their last element, a notable exception to this being the Acorn ATOM. Characters enclosed by quotation marks following a PRINT statement are often referred to as 'strings' but are correctly known as 'literals' or 'literal strings'.

Stringing It Together

A string may contain any characters your keyboard is capable of producing *except* quotation marks, these are used to identify the beginning and end of a string and may not be used within a string. Some computers have special 'quotation marks' that may be used within strings, so if your machine has more than one set of quotes make sure you use the right set at the right time!

The computer, however complex it may appear, is at heart a very simple fellow recognising only numbers and even then, only numbers containing one or two different types of digit. From this simple beginning it has to understand and manipulate the programs we write. Each key we press is reduced to a code in the form 1011000. The 1s are represented by an electrical signal and the 0s are represented by the lack of signal; this makes the binary code (as it is known) one of the simplest ways of storing or recognising a coded signal as each element only has two states . . .either on or off. Each position from the right-hand side represents an increasing power of two; the extreme right-hand position is two raised to the power of zero, so:

$0000001 = 1 = 2^0$
$0000010 = 2 = 2^1$
$0000100 = 4 = 2^2$
$0000110 = 6 = 2^2 + 2^1$
$1000100 = 64 = 2^6 + 2^2$

ASCII It

What has this to do with strings? Well, every keyboard character has its own code and is stored and manipulated as this number. Most computers use the same code numbers for letters, numerals and certain control instructions (Return for example). This code is known as the ASCII code which stands for American Standard Code for Information Interchange . . .no wonder we shorten this to ASCII! The ASCII code for A is 65 (1000001), B is 66 (1000010) through to Z at 90 (1011010). Numerals go from zero at 48 to nine which is 57. One very popular computer, the ZX81, uses its own code where zero is 28, nine is 37, A is 38 and Z is 63. To see what code your computer uses you can use the following routine:

```
10 INPUT A$
20 PRINT "ASCII CODE ";A$;" = ";
   ASC(A$)
30 GOTO 10
```

ASC (A$) returns the ASCII code of A$. For the ZX81 you would have to use CODE A$ to return the Sinclair CODE number.

To find what code number is represented by a given code number, use the following routine:

```
10 INPUT A
20 PRINT A;" IS THE CODE FOR ";
   CHR$(A)
30 GOTO 10
```

(Sinclair users omit the brackets in line 20)
You may get a few surprises with this one as some code numbers represent the control keys as 'clear home' and 'cursor control'!

Stringing Along

It is when we are looking at strings and how computers deal with them that we see the greatest disparity in the different dialects of BASIC. PET, Sharp, Apple and Tandy are similar (but not the same!) whereas the Sinclair ZX81 and Acorn ATOM are quite different.

Hopefully, the following will encourage you to get a little more 'hands on' experience at your keyboard. So if your particular BASIC is not covered here, open up that manual and do something with a few strings. Perhaps you can do more with your computer than you could with that cat's cradle of childhood memories!

What can you do with strings? Probably the best approach is to go through the various commands which refer to strings.

1) You can find the number of characters in a string (including spaces) by using the LEN command. Many applications for this will arise by two simple uses which are:

a) to limit an INPUT string so that when PRINTed this string will not continue to the next line thus spoiling an otherwise immaculate display (!) and

b) some computers will only allow a DATA file name of a given maximum number of characters. In this case, we can use the following:

```
10 INPUT A$
20 IF LEN(A$) > N THEN PRINT "NAME
   TOO LONG":GOTO 10
```

N in line 20 is your specified maximum number of characters and if exceeded, a further INPUT is requested.

2) You can perform comparisons between strings, for example:

```
10 INPUT "DO YOU WANT INSTRUCTIONS
   (Y/N)"; A$
20 IF A$ = "Y" THEN 1000
30 IF A$ = "N" THEN 2000
40 PRINT "I SAID...";:GOTO 10
```

Nearly all BASICs will accept comparisons using the equals sign (=) and most will permit the use of < > (not equal to) so the lines 20-40 above could be re-written:

```
20 IF A$ <> "Y" AND A$ <> "N" THEN 10
30 IF A$ <> "Y" THEN 2000
40 GOTO 1000
```

Sharp's BASIC SP 5205 does not allow the use of < > when comparing strings. One way round this would be:

```
30 IF ASC(A$) <> 89 THEN 2000
```

The ASCII code for Y being 89.

Again, some BASICs will permit the use of < (less than) and >

(greater than). Try the following:

```
10 INPUT A$,B$
20 IF A$ > B$ THEN 50
30 PRINT A$;" IS LESS THAN ";B$
40 END
50 PRINT A$;"IS GREATER THAN ";B$
```

What is happening here? You will find that 'CAT' is greater than 'APE' and that 'BALL' is less than 'BAT'. The comparison is applied to the ASCII code (on CODE value) of the first character within each string and if they are the same, the next character in each string is compared. This continues until a difference is found.

3) You may add strings together (but not subtract); this is known as concatenation — which means to 'link up'.

```
10 A$ = "BULL"
20 B$ = "FROG"
30 PRINT A$ + B$
```

If you RUN the above program you will see 'BULLFROG' displayed. Note that there is no space between the strings. If, for example, you had requested INPUTs for a Christian name and a surname you might not want them to run together, so you would have to include an extra space somewhere:

```
30 PRINT A$ + " " + B$
```

If your BASIC has a limit on how many strings may be concatenated, you may have to add strings in stages:

```
30 A$ = A$ + " "
40 PRINT A$ + B$
```

4) You may cut/slice portions from a string using LEFT$, MID$ or RIGHT$. The results of these operations are known as substrings. For example, if A$="ABCDEFG", then:

PRINT LEFT$(A$,4) gives ABCD (the left four characters).
PRINT MID$(A$,3,2) gives CD (two characters starting with the third).
PRINT RIGHT$(A$,3) gives EFG (the right three characters).

Do check your manual first for how the BASIC on your own machine handles strings. Although I have yet to come across them, I believe some BASICs number the left-hand character as zero and not as in the above examples!

Slicing Through

The ZX81 uses a different system altogether. I'm told it is old-fashioned but I find it easy to use and, in some ways, more versatile. It is referred to as slicing and takes the form: string expression (start TO finish).

So, if A$="ABCDEFG", then:

PRINT A$ (2 TO 5)
gives
BCDE
(second to fifth characters inclusive).

If you omit the start point (2 in the example above) the default condition assumes a 1:

PRINT A$ (TO 5)
gives
ABCDE
(first to fifth characters).

If you then omit the finishing point, the default condition assumes the length of the string:

PRINT A$(3 TO)
gives
CDEFG
(third to end of string).

However, if only one number is in the brackets and there is no TO, then:

PRINT A$ (3)
gives
C
(third character only).

On the ZX81, you may also assign a string to any position within another string:

```
10 LET A$ = "ABCDEFGH"
20 LET A$(2 TO 7) = "LL PUS"
30 PRINT A$
```

This routine will give you 'ALL PUSH' — that surely must give the budding cryptographer some interesting possibilities!

One example using several of the above commands is:

```
10 PRINT "WHAT IS YOUR NAME"
20 INPUT "TYPE SURNAME LAST";A$
30 FOR I = 1 TO LEN(A$)
40 IF MID$(A$,I,1) = " " THEN 60
50 B$ = LEFT$(A$,I)
60 NEXT I
70 PRINT B$
80 END
```

Should you type in your name as 'JOHN DOE', the program will scan the character INPUT until it finds the space between JOHN and DOE (line 40). At the point the computer finds the space, the first name will have already been assigned to B$ (line 50) on the last pass through the IF . . .NEXT loop.

5) BASIC does not allow a number to be assigned to a string — so, A$=1234 will not be accepted. Should you wish to do this, you must either:

a) enter it as an INPUT

```
10 INPUT A$
```

b) or, if a number (x) has been generated within a program, it may be assigned to a string variable using STR$:

```
70 A$ = STR$(X)
```

6) If you wish to reverse the process and extract a number from a string you will have to use VAL. This will return a zero if there are only non-numeric characters within a string and a numeric value if only numbers are present.

VAL("ABCD") gives zero
VAL("1234") gives 1234
VAL("12AB") can give either zero or 12 depending upon which BASIC you are using! Obviously it is important to check which results your machine returns . . .

Having extracted your numeric value using VAL, all the normal arithmetic operations may now be performed.

Next month we will take an elementary look at arrays and if we have time, discuss some of the points raised in the letters I receive from you.

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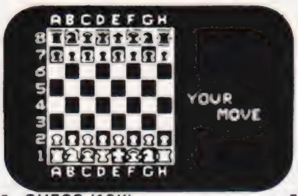

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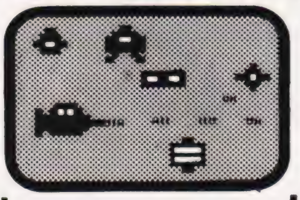

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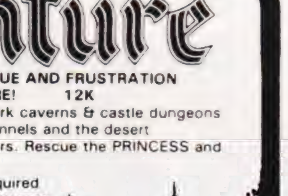

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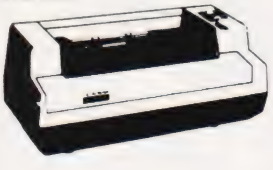

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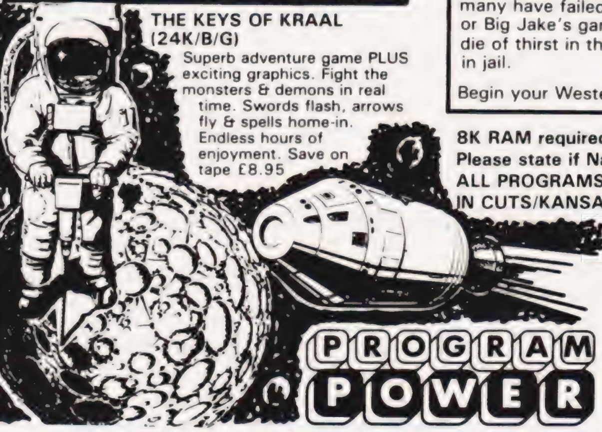

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PROGRAM POWER PROGRAM POWER PROGRAM

Dr G J Marshall

At what point does a package become a language? Well, with GINO-F that distinction has become somewhat blurred. It can now be regarded more as a graphics language than as a FORTRAN program.

GINO-F is a general purpose graphics language. Actually, it is not a formal computer language in the sense that other languages covered in this series are; languages such as BASIC , Pascal and FORTRAN are designed to be completely self-contained, providing all the facilities required by a programmer to describe a computation. By contrast GINO-F provides a set of routines which can be called from a FORTRAN program to generate a particular graphics display.

However, many graphics programs consist of calls to the appropriate GINO-F routines within a minimal FORTRAN framework and to this extent, GINO-F can be regarded as a graphics language (graphics programs are written by combining their routines in much the same way as assembly code programs are written by combining assembly code instructions). Graphic displays can be produced by a number of devices, including high-resolution refresh displays and graph plotters. When a GINO-F program is run, it generates the commands which cause the display device to generate the required image. The analogy with assembly code is that when an assembly code program is run it causes the processor to give the required behaviour when it obeys the successive assembly code instructions.

Picture This

A graphics package called GINO preceded GINO-F; it was developed at Cambridge University and was written in Assembler. The name is derived from the words Graphical Input and Output, which describe the function of the package. The CAD Centre at Cambridge subsequently developed GINO-F, a more systematically designed package, providing for all commonly used graphical activities rather than just for input and output. It is written in FORTRAN, hence the F in its name. As well as being a graphics language, it allows graphical displays to be generated by existing programs when the appropriate GINO-F elements are incorporated.

The package was originally intended for use on mainframe computers but it is currently due for release in a microcomputer version. As the high-resolution displays on microcomputers improve in resolution, and also as good quality graph plotters become readily available for micros, the need for a coherent graphics language such as GINO-F has become more urgent.

At the moment, of course, the graphics facilities available on micros are usually provided by adding extra commands to the BASIC of each micro. This results in the totally different graphics commands possessed by, for example, the Apple, the Acorn ATOM and the Atari. However, it is interesting to observe that the instructions added to these BASICs are quite heavily influenced by the facilities possessed by GINO-F and other similar graphics packages.

Featuring GINO-F

GINO-F is available for a wide range of large computers, providing the portability of graphics programs so completely lacking in microcomputer graphics. There is no standardisation at all in the high-resolution graphics commands and capabilities of microcomputers; when block graphics or character graphics (such as those possessed by the PET) are considered, their usage differs even more widely from one micro to another.

GINO-F also provides programs which are independent of the output device used allowing the output to appear on a high-resolution monochrome display, a colour display or a graph plotter merely by nominating the device to be used at the beginning of the graphics part of the program. Elements which do not apply to the particular device in use, such as colour commands when a monochrome display device is be-

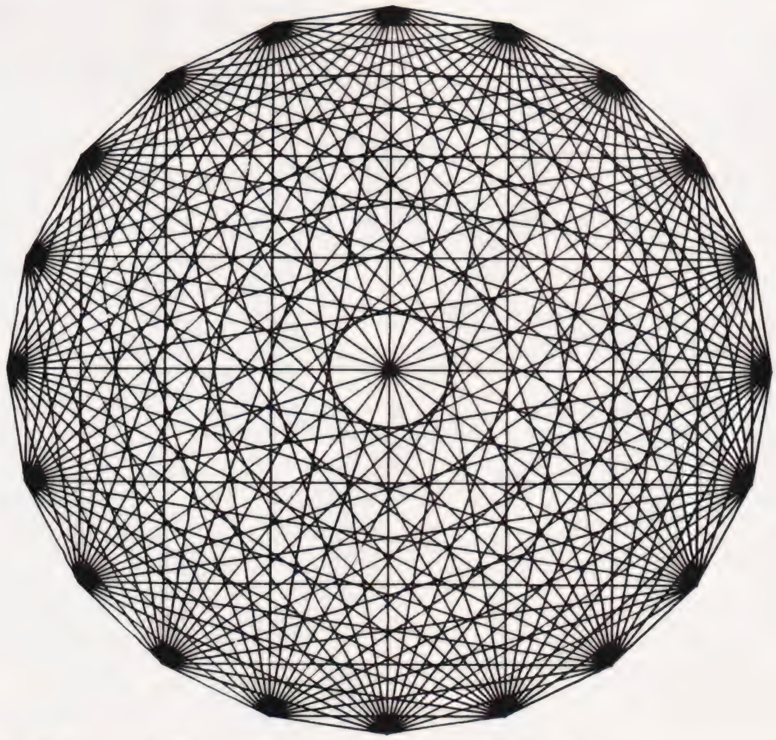


Fig. 1. Is it a circle? Not really, they are all straight lines!

PROGRAMMING LANGUAGES

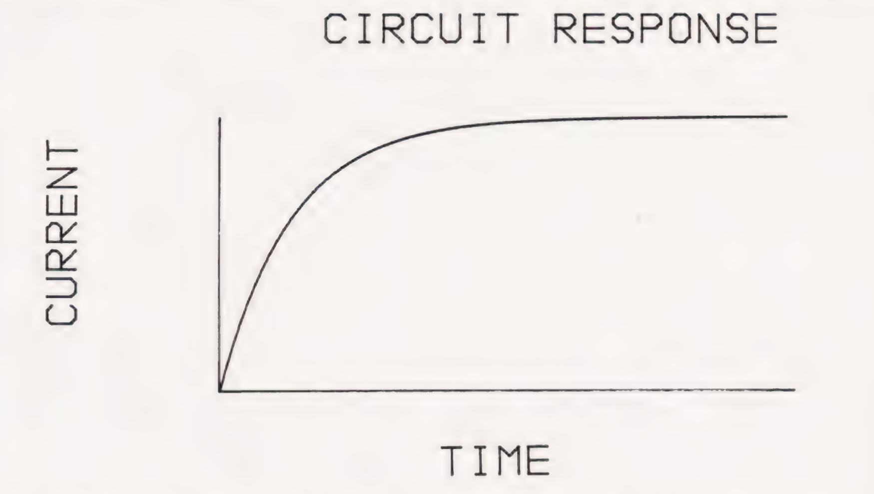


Fig. 2. Plotting the results of a program simulation or even the real thing gives a much more understandable result than a pile of numbers.

ing used, will simply be ignored.

The facilities provided by GINO-F fall into the following categories:

Administrative This group includes the facilities for naming the output device, so that all the commands generated by the graphics program when it is run will be for the output device displaying the picture. It also includes facilities for establishing the size of the picture to be drawn and for ending the graphics part of a program.

Two-dimensional drawing In this group there are facilities for drawing lines and curves and for moving the drawing head to any location without drawing. With these commands any drawing, graph or figure can be produced.

Three-dimensional drawing The facilities for three-dimensional drawing permit any three-dimensional object to be described. The object can be displayed on a (two-dimensional) screen or plotted when the position from which it is to be observed and the projection to be used have been defined.

Transformations Besides the projective transformations for displaying three-dimensional objects, this group includes the transformations of rotation, scaling and shifting for both two- and three-dimensional objects. When a transformation is invoked in a program, it applies to all the drawing commands which follow it. Thus, if the transformation to rotate through 45 degrees is invoked, everything drawn subsequently is rotated through 45 degrees.

Character output With these facilities, characters can be included in a graphic display, for example, to label an axis in a graph. The size and orientation of the characters can be established independently from the rest of the graph.

Interaction These facilities permit interaction with a program, for example, by means of a light pen.

The following simple program will cause a square to be plotted:

```
CALL HP722Ø
CALL UNITS(1Ø.Ø)
CALL MOVTO2(2.Ø,2.Ø)
CALL LINTO2(2.Ø,4.Ø)
CALL LINTO2(4.Ø,4.Ø)
CALL LINTO2(4.Ø,2.Ø)
CALL LINTO2(2.Ø,2.Ø)
CALL DEVEND
STOP
END
```

Note that the graphics part of the program consists of a sequence of calls to GINO-F subroutines. The names of the subroutines usually more or less explain their function. The first call nominates the HP-7220 graph plotter as the output device (incidentally, the diagrams in this article were all drawn on this plotter). The second call fixes the plotting units. By default, the plotting units are millimetres, but this call makes the plotting unit 10 mm.

The next call moves the pen with the pen up (so that no line is drawn) to the point specified. The origin is taken as the bottom left corner of the plotting area, so this call leaves the pen two centimetres above and two centimetres to the right of this corner. The following four calls each cause lines to be drawn from the current position to the position given in the instruction, thereby causing the four sides of the square to be drawn. The call to DEVEND terminates the graphics part of the program, while the last two lines are required to terminate a FORTRAN program. The program draws a square with sides of two centimetres long in a precisely determined position. In much the same way, the position and size of all drawings can be precisely determined.

The next program generates the pattern shown in Fig. 1.

```
      DIMENSION X(2Ø), Y(2Ø)
      CALL HP722Ø
      CALL UNITS(1Ø.Ø)
      CALL SHIFT2(12.Ø,12.Ø)
      ANGLE=Ø.Ø
      AINC=6.2831853/2Ø.Ø
      DO 1Ø I=1,2Ø
      ANGLE=ANGLE+AINC
      X(I)=8.Ø*COS(ANGLE)
      Y(I)=8.Ø*SIN(ANGLE)
1Ø    CONTINUE
      DO 2Ø I=1,19
      IP1=I+1
      DO 3Ø J=IP1,2Ø
      CALL MOVTO2 ( X(I), Y(I) )
      CALL LINTO2 ( X(I), Y(I) )
3Ø    CONTINUE
2Ø    CONTINUE
      CALL DEVEND
      STOP
      END
```

The program computes the locations of 20 points equally spaced around the circumference of a circle and then joins each point to all the others. This is done in a way which avoids drawing each line twice. The way the graphics elements are embedded in a FORTRAN program is clearly shown. The call to SHIFT2 is a transformation which conveniently shifts the drawing into the centre of the plotting area. It effectively moves the origin for the drawing from the corner of the plotting area into the centre.

The simple graph in Fig. 2 was generated by the next program.

```
      DIMENSION X(8Ø), Y(8Ø)
      DO 1Ø I=1,8Ø
      X(I)=Ø.1*(I-1)
      Y(I)=4.Ø*( 1.Ø-EXP( -X(I) ) )
1Ø    CONTINUE
      CALL HP722Ø
      CALL UNITS(15.Ø)
      CALL SHIFT2(4.Ø,4.Ø)
      CALL MOVTO2(Ø.Ø,4.Ø)
      CALL LINTO2(Ø.Ø,Ø.Ø)
      CALL LINTO2(8.Ø,Ø.Ø)
      CALL CURTO2(X,Y,8Ø.Ø,Ø)
      CALL CHASIZ(Ø.4,Ø.4)
      CALL MOVTO2(3.Ø, -2.Ø)
      CALL CHAHOL('TIME .')
      CALL MOVTO2(1.5,7.Ø)
      CALL CHAHOL('CIRCUIT RESPONSE*.')
      CALL MOVTO2(-2.Ø,1.Ø)
      CALL CHAANG(9Ø.Ø)
      CALL CHAHOL('CURRENT*.')
      CALL DEVEND
      STOP
      END
```

The call to CURTO2(X,Y,80,0,0) draws a smooth curve through the 80 points with their x and y coordinates respectively in the arrays X and Y. The calls following CURTO all deal with the characters on the graph. CHASIZ gives the characters' size by fixing their width and height. Each line of characters is positioned using MOVTO2, CHAANG being used to change the angle at which the characters are printed if this is necessary. Finally, the text to be written is given in a call to CHAHOL (the letters to be written are terminated with an asterisk and a full stop).

Any shape which has the x and y co-ordinates of its points stored in arrays X and Y, respectively, can be drawn by a routine such as the following:

```
      SUBROUTINE PLANE
      DIMENSION X(100), Y(100)
      CALL MOVTO2( X(1), Y(1) )
      DO 10 I=2,100
      CALL LINTO2( X(I), Y(I) )
10    CONTINUE
      RETURN
      END
```

The next program fragment generated the shape illustrated in Fig. 3. This shows that once a shape is stored it can be drawn in many ways using the various transformations.

```
      DO 50 K=1,4
      CALL PLANE
      CALL SHIFT2(6.0,1.5)
      CALL ROTAT2(10.0)
      CALL SCALE(0.8)
50    CONTINUE
```

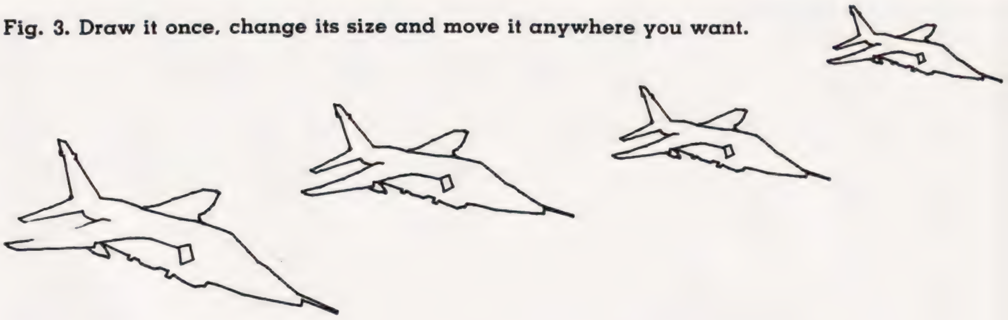
The aeroplane is plotted at its correct size once, but then it is scaled down, rotated and shifted prior to each of the succeeding plots.

3-D Drawing

The realistic display of three-dimensional objects on a two-dimensional surface is made quite easy in GINO-F. A three-dimensional object is described by giving the instructions for 'drawing' it in three dimensions. Before the object is displayed on a screen or plotted, the position from which it is to be viewed and the direction of viewing must be given. Then, calling the transformation routine VIEW automatically causes the appropriate perspective view of the object to be drawn when the three-dimensional drawing commands are executed. Program listing 1 produced the drawings shown in Fig. 4.

The description of the object is embodied in the 24 three-dimensional drawing calls to MOVTO3 and LINTO3. The call to the routine VPOINT establishes the viewpoint and the direction of viewing; using different values for x, y and z in this routine is all that is necessary to generate different views of the object.

Fig. 3. Draw it once, change its size and move it anywhere you want.



On Your Micro

GINO-F is currently due to be released for the Research Machines 380Z. This particular machine supports FORTRAN allowing the graphics package to be made available in essentially the same form as for mainframe machines as a set of FORTRAN subroutines. Thus, at least one micro will support a powerful and coherent graphics language.

The high-resolution displays possessed by micros such as the Apple, the Acorn ATOM and the BBC microcomputer can display complex and detailed images, and they deserve a language making it comparatively easy to produce such images. Of course, they can produce impressively detailed images including displays of three-dimensional objects (the manual provided with the ATOM includes a program for generating perspective views of a convoluted surface, the results of which are most impressive) but considerable study is necessary to understand how the program works. All effects are produced from first principles and the perspective transformation is explicitly programmed. If you wish to fully understand the techniques of computer graphics, this is fine, but it makes life very difficult for the user who merely wants to take advantage of the graphics for a particular application.

```
      DIMENSION X(4),Y(4),Z(4),U(4),V(4)
      CALL HP7220
      CALL UNITS(12.0)
      DATA X/5.0,0.0,5.0,3.0/
      DATA Y/4.0,5.0,0.0,2.0/
      DATA Z/3.0,3.0,3.0,3.0/
      DATA U/5.0,15.0,5.0,15.0/
      DATA V/5.0,5.0,12.0,12.0/
      DO 10 I=1,4
      D=SQRT( X(I)*X(I)+Y(I)*Y(I)+
      Z(I)*Z(I) )
      CALL VPOINT(X(I),Y(I),Z(I),-X(I),
      -Y(I),-Z(I),D)
      CALL VPOSIT(U(I),V(I))
      CALL VIEW
      CALL MOVTO3(-1.0,-1.0, 1.0)
      CALL LINTO3( 1.0,-1.0, 1.0)
      CALL LINTO3( 1.0,-1.0,-1.0)
      CALL LINTO3(-1.0,-1.0,-1.0)
      CALL LINTO3(-1.0,-1.0, 1.0)
      CALL LINTO3( 1.0, 1.0,-1.0)
      CALL LINTO3(-1.0, 1.0,-1.0)
      CALL LINTO3(-1.0, 1.0, 1.0)
      CALL LINTO3( 1.0, 1.0, 1.0)
      CALL LINTO3( 1.0, 1.0,-1.0)
      CALL LINTO3( 1.0, 2.0,-1.0)
      CALL LINTO3(-1.0, 2.0,-1.0)
      CALL LINTO3(-1.0, 2.0, 1.0)
      CALL LINTO3( 1.0, 2.0, 1.0)
      CALL LINTO3( 1.0, 2.0,-1.0)
      CALL MOVTO3(-1.0, 2.0,-1.0)
      CALL LINTO3(-1.0, 1.0,-1.0)
      CALL LINTO3( 1.0,-1.0, 1.0)
      CALL MOVTO3( 1.0,-1.0,-1.0)
      CALL LINTO3(-1.0, 1.0, 1.0)
      CALL LINTO3(-1.0, 2.0, 1.0)
      CALL MOVTO3( 1.0, 2.0, 1.0)
      CALL LINTO3( 1.0, 1.0, 1.0)
      CALL LINTO3(-1.0,-1.0,-1.0)
      CALL TRANSF(2)
10    CONTINUE
      CALL DEVEND
      STOP
      END
```

Listing 1. A GINO-F program to produce the objects shown in Fig. 4.

The widely differing nature of the graphics commands provided by the BASIC languages of various micros can be illustrated quite simply. The programs equivalent to the GINO-F program given above to plot a square are, for the Apple:

```
10  HGR:HCOLOR=3
20  HPLOT 20,20
30  HPLOT TO 20,40
40  HPLOT TO 40,40
50  HPLOT TO 40,20
60  HPLOT TO 20,20
```

and for the ATOM:

```
10  CLEAR 4
20  MOVE 20,20
30  DRAW 20,40
40  DRAW 40,40
50  DRAW 40,20
60  DRAW 20,20
70  END
```

Clearly the two BASICS possess broadly equivalent commands but a good deal of translation needs to be done to convert a graphics program from one machine to another. Just as annoying is the fact that neither program generates a square — they produce rectangles whose size and shape depend on the resolution provided by the system. Both PLOT TO X,Y and DRAW X,Y draw a line from the current position to the dot in the screen position in column x and row y.

A further complication with these two machines is that the screen origin (ie the dot in column 0 and row 0) is the bottom left for the ATOM (as you might expect), but at the top left for the Apple. Consequently, two programs that are apparently equivalent give rectangles not only different in size and shape but also occupying different positions on the screen. (It should perhaps be mentioned in passing that there are alternative ways to write these programs using different graphics commands for both the Apple and the ATOM.)

The problems of a language designer wondering which graphics commands to add to the BASIC of a particular micro could be resolved by turning to GINO. Although GINO-F is written in FORTRAN, there is no reason why an equivalent version could not be written in BASIC; such a version would be ideal for micros, providing a general-purpose graphics language which could be added to any BASIC as required. This would make it far easier to tap the potential power of the graphics on any micro with high-resolution facilities.

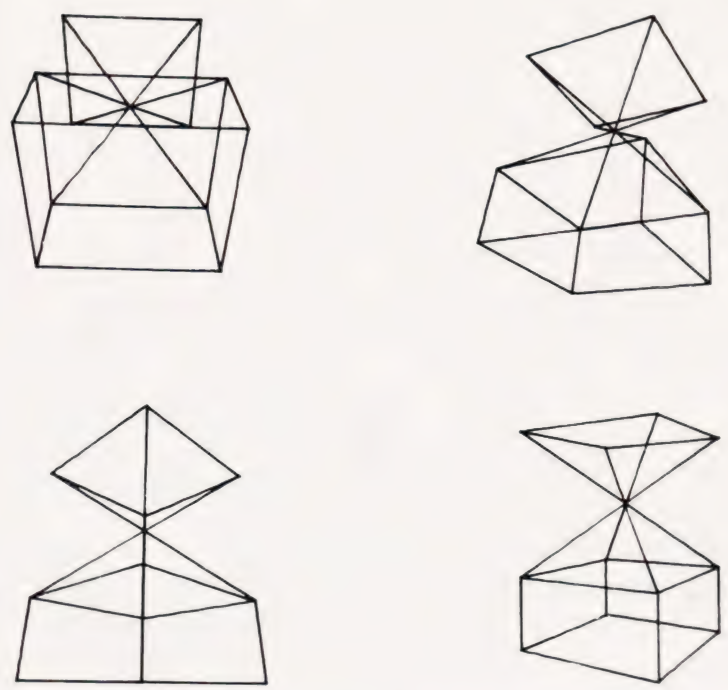


Fig. 4. Three-dimensional plotting drawn in two dimensions. Note that we are not removing the hidden lines in this instance.

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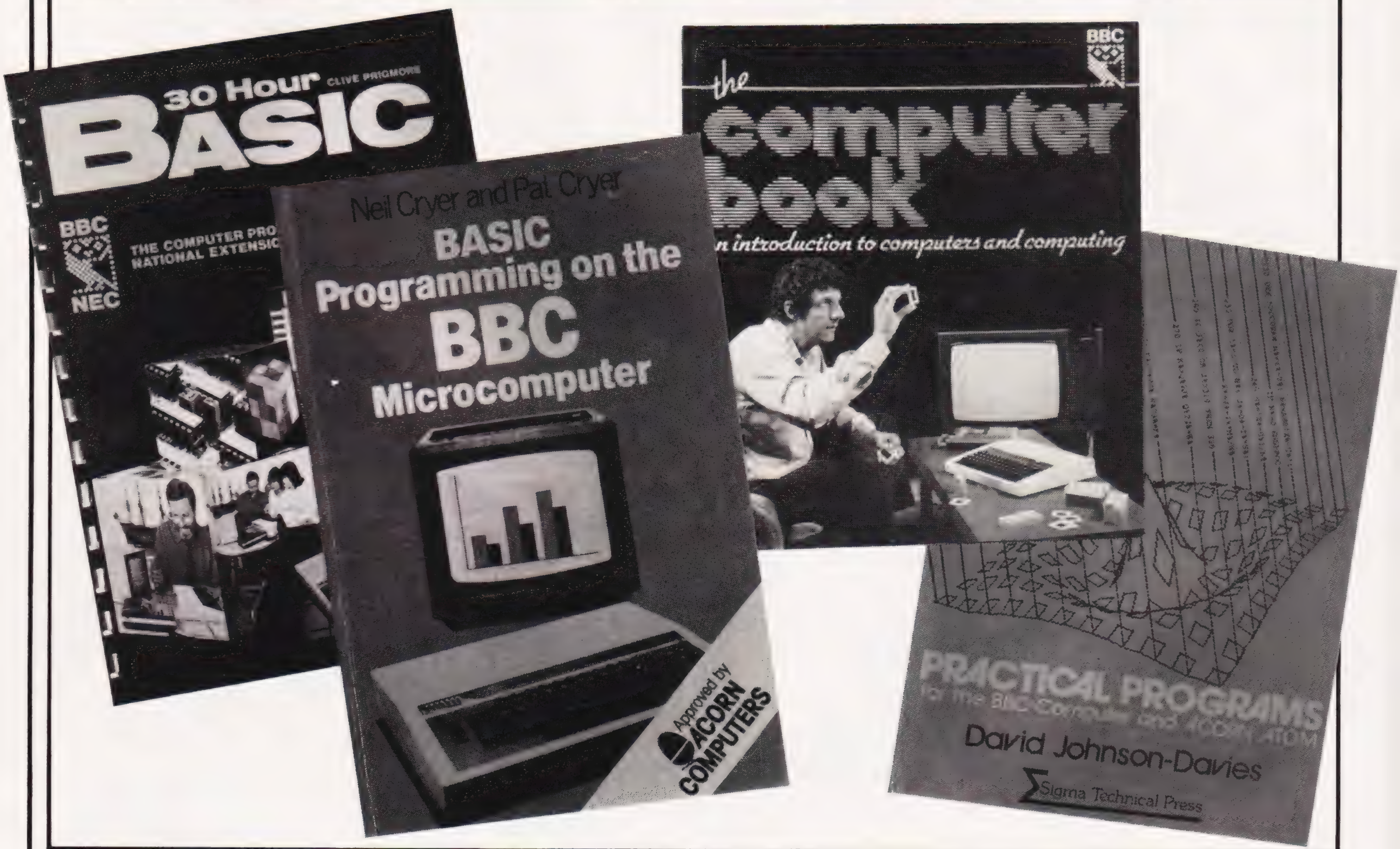
S M Gee

With the BBC Micro at last beginning to become available in reasonable quantities, the market for books on the system seems to have taken off in a big way. We review some of the offerings currently available.



The BBC Computer Literacy project has been with us for some months now but I imagine its impact is likely to be cumulative rather than a seven day wonder. As time goes by, more and more people will have seen Chris Serle, Ian McNaught Davis and Gill Nevill bringing the wonders of computer technology into our living rooms.

The BBC publication, **The Computer Book**, doesn't accompany the TV series in the sense of being directly linked to it but it does introduce the subject in a rather similar way. It puts the subject into a wide ranging context. It also tends to introduce the subject by the back door as if there was something not quite proper in being enthusiastic about computers — but then of course not everybody is excited about computers and there are still a lot of people suspicious of them.

The style of the beginning part of the book seems intended to woo the computer-shy, and even the computer-phobes, into sufficient confidence to delve further into it. However, it is unfortunate that the boldness of the title (proclaiming, without further ado, that it is about *the* computer) may dissuade this particular audience to open its covers.

Among the people who are likely to buy it, however, are those who have a genuine interest in computers but don't know the first thing about them. How are *they* likely to respond to it? Well, they may feel that it's rather hard work initially to find the real matter of the book — the first chapter takes the reader from weather satellites via tin cans to washing machines before computers *per se* are really introduced. Once they find their bearings, however, those who read this book are likely to agree with me that it really does cover a lot of ground in a pleasant and relaxed fashion and that everything needed to introduce the subject of computing is there and well explained.

What about those of us who already know quite a bit about computers — the ones who range from enthusiastic to frankly fanatical. With a title like that you'd expect it to appeal to the computer-phile. Speaking as one of this growing group (**!* Ed**) I liked the gentle introduction, which puts computer technology into a wider context than I normally contemplate. The explanation of BASIC is a refreshing one giving a rather different insight into programming; I also enjoyed the discussion of further and future developments in the final chapter.

In conclusion, **The Computer Book** does not actually introduce anything new but wraps up all the

BOOK PAGE

essential points, plus quite a few extra ones, in an attractive style. Good use is made of the second print colour — a cheerful red — allowing flow diagrams and programs to stand out well from the surrounding text. There are lots of photographs and last, but by no means least, there is a family of very appealing bird characters used to illustrate the book who certainly kept me amused.

There *is* a direct connection between the National Extension College's **30 Hour BASIC** and the BBC Literacy Project in that this course has been specially written for the project and is being promoted in conjunction with the television series. It does not, however, rely in particular on the BBC Micro. Indeed, the introduction to the book suggests that you can do the course without a computer at all!

In some ways, this leads to a weakness in the book as far as those who do have access to a machine are concerned. It leads to a tendency to tackle the subject in a long-winded way concentrating on theoretical issues rather more than other BASIC instruction manuals. Having said that, its concentration on flow charts means that it does teach you more than how to write programs — it teaches you how to write good, clear logical programs.

You can follow this course as an NEC correspondence student; the publication has the unmistakable hallmark of a coursebook — it is methodical and has a style which could be described as 'sober'. This is by no means intended as a criticism. There are plenty of alternative texts to choose from if you want to learn BASIC and many of them take flippancy to a distracting extreme! Lots of people do prefer less jokey explanations and this particular text will appeal if you favour a disciplined approach.

Neil and Pat Cryer have also produced an introductory book on BASIC to link with the BBC's computer literacy project and is specifically intended for use with the BBC Micro — a machine they are obviously enthusiastic about. Their book, **BASIC Programming on the BBC Microcomputer**, is approved by Acorn (who manufacture the BBC Micro) and they were helped by those concerned with the machine's hardware and software in its preparation, so it has been tailored to the peculiarities of BBC BASIC.

This is a well written introduction to BASIC, the explanations are clear and there are plenty of sample programs. It is a practical book as its format makes obvious — there are frequent sections devoted to 'activities' which the reader is expected to do. Another feature is that toward the end of each chapter there is a section entitled 'Some points to think about'. This is invariably followed by a section called 'Discussion on the points to think about' which gives you the solutions to the problems posed. It is rather a shame that these two sections are not separated as, unless you make an effort to hide the answers, you are tempted not to think through the problems for yourselves.

The final section of each chapter is a discussion of the activities suggested earlier and is intended to consolidate what should have been learnt through them. This is particularly helpful as it draws attention to many points, both major and minor, which otherwise might have escaped notice.

Special features of BBC BASIC are covered — there are two chapters on its graphics, one on animation and one covering programmable characters and sound. Personally, I would have liked to have seen more attention paid to sound and to the ENVELOPE command which is an interesting way of defining irregular sounds. Also, I would have expected a book focussing on BBC BASIC to have paid more attention to the user-defined procedures. This is only introduced very near the end of the book whereas, had it been discussed earlier, programming examples in the areas of graphics, mathematical functions and string handling, could have been made simpler and more generalised by using procedure calls and procedure definitions.

All in all, the Cryers and Prentice-Hall International have done well to produce a book on the BBC Micro so quickly. It is an introductory volume so let's hope they go on to produce another one for the more advanced level — and please include more of the drawings of the 'absent-minded professor' character next time.

Sigma's title for the BBC Micro and the Acorn ATOM, **Practical Programs for the BBC Computer and the Acorn ATOM**, is a nicely presented and clearly laid out paperback *but* it is rather slim. There are three or four programs in each chapter, each of which is presented in two versions — the first for the BBC machine (in which good use is made of procedure calls) and the second for the ATOM.

The structure of the programs is clearly indicated by the use of one or two line explanations printed as boxed headings above the relevant section of code. Chapter one contains three very short and rather traditional games programs which do not make special use of any of the BBC Micro/ATOM's special features. Chapter two is entitled 'Graphs' but the programs it contains are not for histograms or plots but instead draw beautiful patterns on the screen. Again, they are very short routines. Chapter three has three programs for word games and one for cataloging records, telephone numbers, book titles, etc. There are three programs in Chapter four: the first carries out arithmetic in traditional fraction form rather than in decimal numbers; the second simplifies polynomials; and the third is a Reverse Polish calculator — which seems a bit esoteric until you realise it will enable you to do your sums to unlimited accuracy.

Chapter five is by far the most interesting of the book and is also the longest. It presents an SPL compiler for which the complete code is given. SPL stands for Simple Programming Language so Johnson-Davies is providing another high level language for the BBC Micro and the ATOM. More importantly, he gives an excellent example of how to write a simple compiler.

The books included in this month's selection were:

The Computer Book by Robin Bradbeer, Petér De Bono and Peter Laurie, published by BBC Publications (1982), 208 pages, £6.75.

30 Hour BASIC by Clive Prigmore, published by the National Extension College (1982), 254 pages, £5.50.

BASIC Programming on the BBC Microcomputer by Neil and Pat Cryer, published by Prentice Hall International (1982), 208 pages, £5.95.

Practical Programs for the BBC Computer and the Acorn ATOM by David Johnson-Davies, published by Sigma Technical Press, distributed by John Wiley & Sons Ltd (1982), 120 pages, £5.95.

CT STANDARDS

If you've ever wondered just what those funny symbols in other people's programs mean you need our standard codes.

It has been very encouraging to see the number of programs submitted using our standard codes for graphics and other non-printable characters. However, it has also become increasingly clear that some of our readers haven't heard of them and this page is intended to set them out once again.

All standards tend to be irksome to adhere to but the ones laid out here are fairly simple and tend to make software easier to maintain by the programmer and simpler to understand for others.

Controlling That Cursor

It is fair to admit that the standards arose because, in the early days, we had a printer which could not reproduce the graphics characters produced by the PET (among others). One soon learned that a mysterious '3' appearing in the listings actually meant 'clear screen' but many of the other characters simply disappeared making documentation extremely difficult.

The original standards that emerged were simply aimed at getting round this problem and it is a tribute to their simplicity that they are becoming widely accepted. (Indeed, a whole series of books is using them as its de-facto standard.) The standards for the cursor controls are given in Fig. 1.

[CLS]	CLear Screen
[HOM]	HOMe the cursor
[CL]	Cursor Left
[CR]	Cursor Right
[CU]	Cursor Up
[CD]	Cursor Down
[REV]	REVerse video on
[OFF]	Turn it OFF
[SPC]	SPaCe character

Fig. 1. The original cursor control codes which are still doing sterling service.

To indicate more than one of the above, an optional number can be placed within the brackets; [4 CL], etc.

The use of square brackets has raised one or two interesting queries. The actual reason for this choice is that *most* of the common microcomputer BASICs don't use them for specific functions. In fact, at least one machine provides an added bonus by returning a syntax error if they are found, a useful check in case you type them in by mistake.

The code [SPC] was added to the list of cursor control codes to get over the problem of indicating just how many spaces are contained in that gap in the printout. It is interesting to note that when the National ZX81 Users' Club published a set of programming standards specific to that machine, they found the same problem. The code they chose to use was '*'.

The code [RVS] has caused a few headaches. This is really specific to the PET where the character set can be displayed in reversed video. On machines which don't have this facility you should either find a character in the set which is the reversed image of the one you want and use that or simply ignore it and use anything else you fancy! Don't forget, you may have to look up and alter the values used elsewhere in the program.

The Graphic Solution

It soon became obvious that the techniques applied to the confusing cursor controls could also be applied to the graphic symbols. The following standard is now in general use in programs published in Computing Today.

If a graphics character or characters are to be displayed in a listing (as opposed to POKE codes or CHR$( ) codes) then they are indicated by the method shown in Fig. 2.

Several people have asked what the relationship between the POKE value for a character and that of its shifted graphic might be. In general the shifted version of any character will be 64 greater than the value of that character. This applies to both PET and MZ-80K systems in all cases.

This can be taken further to include machines which use a pixel graphics set rather than preprogrammed PET-style characters and the series of codes for these is given in Fig. 3. As is nearly always the case there is one machine to which the standard shown in Fig. 3 does not apply — Tangerine's Microtan/Micron. This machine uses a four by two cell structure for its pixel graphics instead of the Prestel/Teletext three by two cell. The method for calculating the value to assign to 'P' is shown in Fig. 4, and is fortunately nice and simple.

Making REMarks

Many people scorn the use of REMs within programs but, during the development at least, they are extremely useful. One of the documentation methods that we use is to keep our back-up copy of our programs on a 300 Baud CUTS tape with all the REMs in place: the working copy, be it on tape or disc, is REMless in order to save space.

It is also good programming 'manners' to give your REMs odd line numbers:

```
3999 REM ** CRASH PROOF INPUT
4000 INPUT "THE NUMBER OF ENTRIES ";A$
```

A remarkable number of submitted programs have jumps that go not to the relevant point in the program, but to the REM statement. This can cause severe problems when renumbering after removing the REMs. The format in which we publish the REMs is shown in the previous example; two asterisks between the REM and the comment with the latter in capitals.

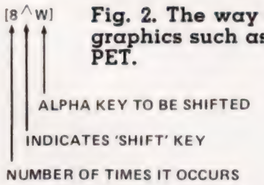


Fig. 2. The way we indicate block graphics such as those on the Sharp and PET.

1	2
4	8
16	32
64	128

Fig. 4. To convert a Tangerine pixel code into its blocks, simply decode the number into its binary or Hex value and fill in the relevant squares.

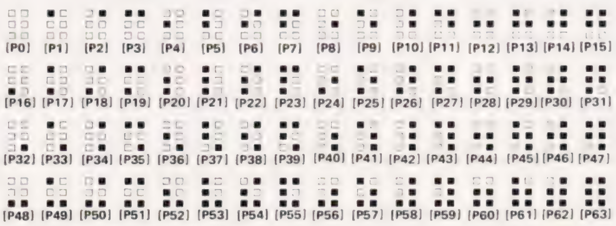


Fig. 3. The standard pixel codes; they will work on most computers which this technique as well as for Teletext and Prestel.

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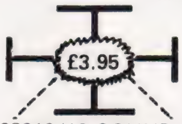

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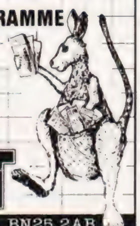

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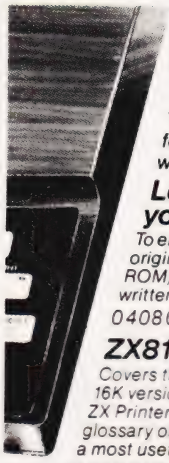

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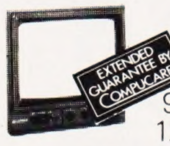

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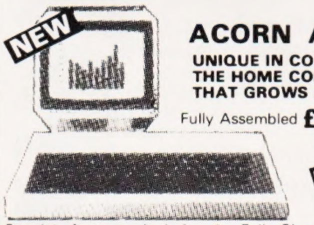

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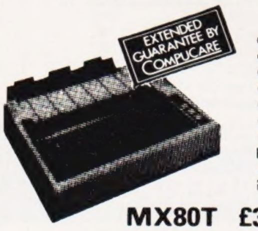

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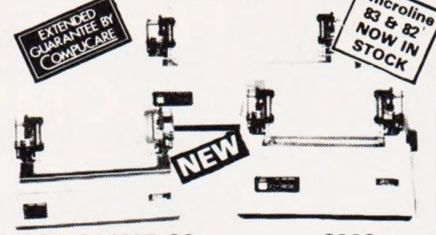

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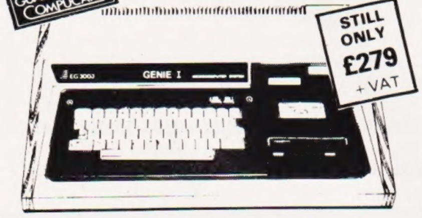

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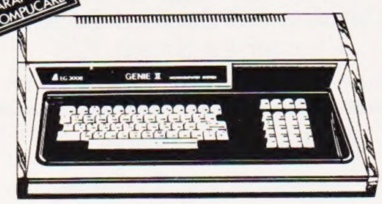

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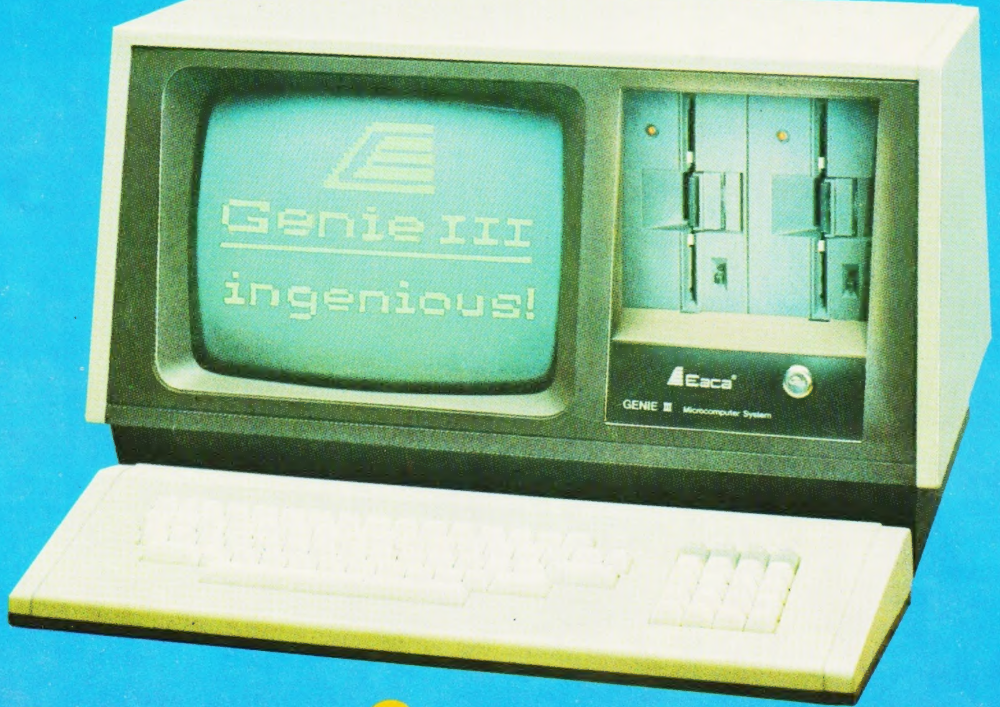

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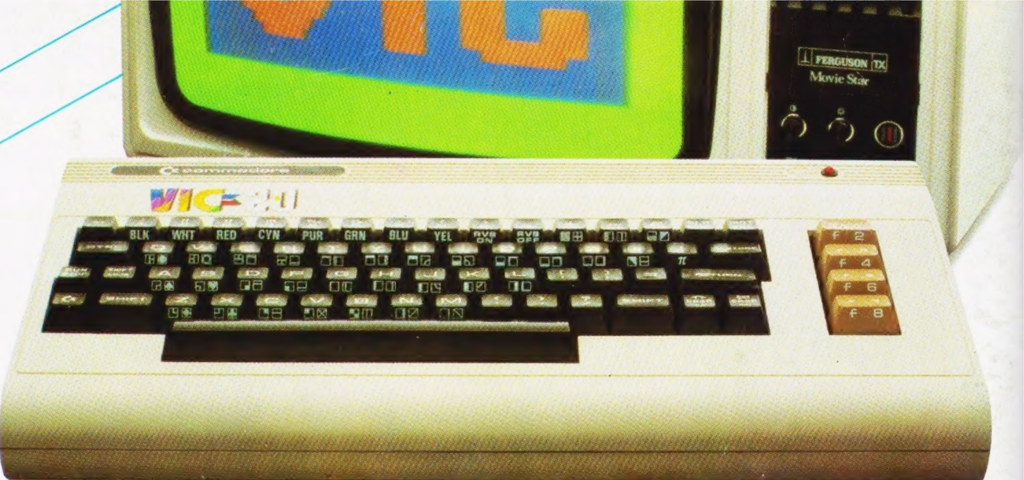

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